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Biennial Report 1954-1956.

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FORTY-FOURTH BIENNIAL REPORT

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CALIFORNIA DEPARTMENT OF FISH AND GAME

FORTY-FOURTH

BIENNIAL REPORT

DEPARTMENT OF FISH AND GAME

July 1, 1954, through June 30, 1956

COMMISSIONERS
ANDY KELLY, PRESIDENT
LOS ANGELES
CARL F. WENTE
SAN FRANCISCO
WILLIAM P. ELSER
SAN DIEGO
WELDON L. OXLEY
REDDING
THOMAS H. RICHARDS, JR.
SACRAMENTO

GOODWIN J. KNIGHT
GOVERNOR

SETH GORDON
DIRECTOR

STATE OF CALIFORNIA
Department of Fish and Game

722 CAPITOL AVENUE
SACRAMENTO 14, CALIFORNIA

To His Excellency, Goodwin J. Knight
Governor of the State of California
Sacramento, California

Sir:

We have the honor to submit herewith the Forty-fourth Biennial Report, covering the period July 1, 1954, through June 30, 1956.

This report covers a period of intense activity by state agencies and others interested in the development of California's water resources for varied purposes. It describes fully the role of the Department of Fish and Game in these activities.

The report also contains accounts of the activities of the Wildlife Conservation Board, the Marine Research Committee and the various branches of the department in fostering the conservation and wise use of the State's wildlife resources.

A summarization of important policy decisions by the Fish and Game Commission affecting wildlife is also included.

Respectfully submitted,

Seth Gordon

Director

Cover Picture. Salman leaping Burnt Ranch Falls at the Trinity River, approximately 30 miles west of Weaverville.
(Fish and Game Photo by E. P. "Phil" Pister)

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STATE OF CALIFORNIA

DEPARTMENT OF FISH AND GAME

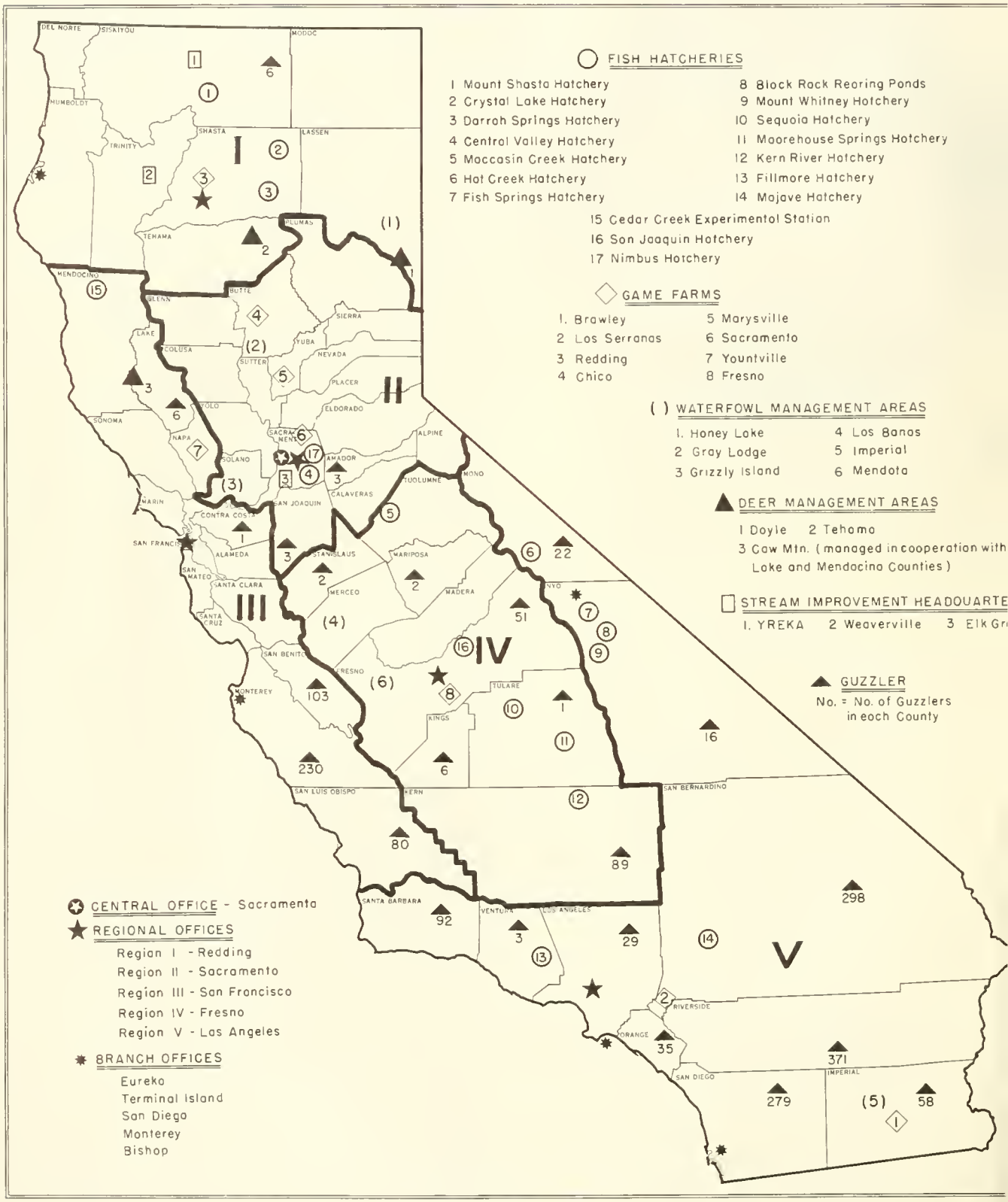
GOODWIN J. KNIGHT, *Governor*

FISH AND GAME COMMISSION

Andy Kelly, President, Los Angeles

William P. Elser, San Diego
Weldon L. Oxley, Redding
Carl F. Wente, San Francisco
Thomas H. Richards, Jr., Sacramento

Department of Fish and Game Major Installations, 1956



FISH AND GAME COMMISSION

Commissioners who molded Fish and Game policies thraughaut most of the biennium. Left to right: Harley E. Knox, elected commission president in Jonuory, 1956; Carl F. Wente; William J. Silva, elected president in January, 1954, and re-elected the following year; Weldon Oxley; and Andy Kelly, who succeeded Lee F. Payne, whose term expired in December, 1954.

(Fish and Game Photo)

A comprehensive history of the California Fish and Game Commission and its various predecessors, stemming from the State Board of Fish Commissioners established in 1870, was published this biennium as a part of the administrative survey of the agency by the Legislative Auditor.

This history detailed various historical changes since passage in 1852 of the first California fish and game law. It also reviewed the most recent basic change in 1952 which accompanied reorganization of the agency into a department, relieving the commission of responsibilities other than policy formulation and regulatory functions.

In 1956, the late Harley Knox, Commission President, invited the Attorney General's opinion as to the responsibilities of the commission. This opinion held that the department's budget and fiscal matters, as they reflect the programs and activities of the department, are matters of policy for which the commission is responsible. On this basis, the commission actively participated in the planning of the 1957-58 Fiscal Year budget and programs, and formally approved the budget prior to its presentation to the Legislature.

At the biennium's end the commission was studying various ways and means of increasing revenues in preparation for recommending appropriate changes to the Governor and Legislature.

Also pursuant to said advice, the commission revised its state-wide trout policy in April of 1956 by stipulating that everything possible shall be done to aid and protect natural production by protection and improvement of habitat. It further decided that artificial trout propagation will be used where necessary. It also established a minimum of 7½ inches in length for catchable-size trout, and determined that such trout will be planted only in heavily fished roadside lakes or streams where at least 50 percent or more will be taken by anglers.

The commission concurred with the U. S. Fish and Wildlife Service in establishing a coot and widgeon special season in Imperial Valley to relieve crop depredations and also concurred in the establishment of a similar season on coots for certain counties in the San Joaquin Valley.

In order to provide protection to a larger number of nursery stock, the commission increased the minimum size limit on striped bass from 12 to 16 inches.

IMPORTANT NEW STEPS TAKEN

The commission implemented its 1950 deer policy by providing for a 38-county either-sex deer hunt for the first time. The commissioners personally conducted many of the public hearings on the matter as required under the law.

In November, 1954, the commission established the first open season on chukar partridges, with such success that it has been continued annually and the area where these birds may be taken has been enlarged.

The commission also initiated the plan by which hunters may obtain advance reservations for hunting on various waterfowl management areas operated by the department. The program has proved most successful and popular with waterfowl hunters.

New Procedures

Procedures by which matters such as departmental recommendations for regulations and seasons would be made available to the public well in advance of their official consideration at commission meetings were also initiated by the commission and put into effect by the department.

On a number of occasions during the biennium, various commission members, who serve without compensation, reaffirmed a traditional stand of the commission, by pointing out that regulations are set first for the welfare of the wildlife concerned, and secondly for the convenience of the public where such regulation will not endanger the future of wildlife.

REPORT OF THE DIRECTOR

Lag dam built in 1954 by the department on Little Bear Creek, San Bernardino County, to create a trout pool.
(Fish and Game Photo by B. H. Unruh)

How to maintain waters for fishing, hunting and other outdoor recreation in the face of accelerating development of water for other purposes is the most challenging problem ever to face Fish and Game people in California.

This problem has been daily confronting the department during the last decade, and in the past two years has been highly intensified as a wide variety of water developments have taken shape on many of California's major streams.

The Golden State is growing at such an accelerated rate that its effect has sometimes been termed "explosive." On July 1, 1946, there were 9,559,000 residents in California. Only 10 years later the figure had grown by 4,000,000—and of these, 1,000,000 arrived during the biennium just completed.

Problem Highlighted

In another two years there may be a population of 15,000,000. Most of this growth has been in water-short Southern California, a fact which dramatically highlights the problem facing state authorities: the north has the water and the south has the need. The solution is obvious: export excess water to the areas of need. Not so obvious to the general public are the problems which this solution has posed for matters of fish, game and recreation.

Each new appeal to the State for water for highly important domestic, agricultural and industrial purposes called for immediate answers from the Department of Fish and Game as to how fish could be protected. The growing demands for water and the department's legal responsibility to protect fish and game needs have taxed personnel to the utmost. Preparations for hearings, which have greatly increased during the period, and the necessity to appear personally to testify for the department, began to usurp the full time of more and more department personnel who had to be relieved of other duties to concentrate their efforts on the preservation of inland waters for wildlife.

The department, pursuant to the policy adopted by the Fish and Game Commission, has continued to recommend reserving water for fish, wildlife and recreation, without success. Legislation is essential to preserve the contribution that fish and game make to the economy of California and to provide the other outdoor recreational opportunities that will be required by the State's expanding population.

CALIFORNIA WATER PLAN

The new California Water Plan occupied a great amount of the department's attention during the biennium, and rightly so. For the plan not only projects

and provides for the State's ultimate consumptive water needs, but it also forecasts a large share of its future in outdoor recreation.

By direction of the Legislature, recreational uses of water had to be considered during the formulation of the California Water Plan. The Department of Water Resources went a step further than this when it announced, in early 1956, it would urge the Legislature to consider recreation as a "beneficial use" in the following recommendation:

> "Additional legislation that will be necessary for full implementation of the California Water Plan should be enacted as required. This includes provisions authorizing the planned operation of ground water basins as reservoirs, when necessary in the public interest. It also includes provisions authorizing the maintenance of live stream flow in the interest of fish, wildlife and recreation as a beneficial use of water."

The first preliminary investigations into the effects of the California Water Plan on the State's wildlife were undertaken during the biennium by competent fisheries biologists working side by side with the engineers of the Department of Water Resources. Their report will form Appendix "E" of the plan, soon to be published, but it is by no means the final, definitive study of the subject. At best it can be considered only a quick look at the steps necessary to enhance recreational opportunities under the plan. Much more study is needed. Each phase of the plan must be thoroughly studied in detail as it develops from the drawing board to the construction stage, and recommendations for wildlife and recreation must be made integral parts of the project.

OROVILLE DAM

Oroville Dam, which will harness a large portion of the Feather River, will be the first unit to be constructed under the California Water Plan. Consequently, the department has given a high priority to development of plans for fishing, hunting and recreation in the upper Feather River area. The department had recommended five reservoirs whose primary use would be for recreational purposes. The 1956 Legislature voted a total of $658,000 for preliminary planning of and site acquisition for the dams and the engineering investigation phase of preliminary planning was under way at the close of the biennium. The next step will be final plans and construction.

Biologist Edward Dwyer, left, and Water Resources Engineer William L. Horn confer on wildlife protection phases of the California Water Plan. (Fish and Game Photo)

Studies of flow releases from Oroville Reservoir, necessary to maintain salmon spawning runs in the Feather River, have been made, as well as a preliminary survey of the wildlife and recreational needs of the Oroville Reservoir area. Preliminary investigations on the need for a salmon hatchery downstream from Oroville Dam were under way at the close of the biennium. Fish and Game biologists, working with engineers of the Department of Water Resources, were also investigating the need for fish ladders and other structures where feasible.

On advice of the Department of Fish and Game, the California Water Plan includes provisions for dams on some north coastal streams which will be designed primarily for fish life and recreation purposes. The Department of Water Resources hopes that these streams, with adequate flows, can replace some spawning areas inundated by bigger dams.

Most of these streams have high recreational use, but only for limited periods of each year. Sand bars, resulting from low flows in late summer and fall, now block the mouths of these streams and cut off access to salmon and steelhead trout. Spawning runs are thus delayed and consequently the fishing period is limited. Small fish on their downstream runs are often trapped and die when low flows occur again the following summer.

By controlling releases from dams on the upper reaches of these streams, summer flow and the fish producing capacity can be greatly increased. Control of releases will also mean an improvement in fishing, camping and picnicking opportunities.

MIGRATORY FISH LOSS

The State stands to lose a substantial segment of its migratory fish life when the plan is carried to its ultimate development. Hatcheries, ladders, diversion screens and other devices will help to restore partially some of these fisheries, and assurance of constant flows below dams will improve some trout streams. The loss will be further offset by creation of many warmwater fishing lakes, some in areas that do not now have any semblance of water recreation.

Constant vigilance by the department and others interested in outdoor recreation is necessary as each phase of water plans develop. Provision for wildlife and recreation must be included in construction plans of projects if California is to be assured a substantial

Wood products plant on Sacramento River near Antioch pumps waste materials directly into stream, creating condition highly toxic to fish.
(Fish and Game Photo by John Skinner)

future in outdoor recreation. Existing reservoirs which have been built without consideration for recreation present a valuable lesson to the people of California. It is extremely expensive to provide for this purpose after a dam is built.

THE GRASSLANDS BILL

Probably the most important single accomplishment for conservation of California wildlife during 1954 was passage of legislation by Congress of the so-called Grasslands Bill.

The Grasslands of the San Joaquin Valley were a major waterfowl wintering area on the Pacific Flyway before they were dried up by the U. S. Bureau of Reclamation as part of the Central Valley Project water development plan. The Grasslands Bill was based on results of a joint survey by the bureau, the Department of Fish and Game, and the U. S. Fish and Wildlife Service.

The new law authorized the Secretary of the Interior to contract for delivery of water, if and when available, to public organizations and agencies for waterfowl purposes in the Grasslands at a cost not to exceed the charge for Class 2 water. The law also provided for investigation, planning and construction of works by the U. S. Government to provide water for the public waterfowl management and refuge areas in the Grasslands Region, the cost to be borne by the government on a nonreimbursable basis. The expenditure of $400,000 was authorized for the purpose and when completed the works were to become the property of the State of California. A substantial start had been made on the rehabilitation of the wildlife needs of the area during the biennium.

OTHER PROBLEMS

While the department was busy with its primary water problems, there were many other matters that also commanded its attention. Chief among these were finances, deer management, and still another water problem, pollution.

Possibly the most serious, insofar as the immediate future is concerned, was the fiscal problem.

For five years, increasing revenues have failed to keep pace with inflation, costs of wildlife conservation programs and services to the public.

The $6,000,000 Fish and Game operating reserve of 1951 will be about $2,760,000 by June 30, 1957. It will be about $1,700,000 a year later at the present austere rate of spending.

In 1947 the State Legislature, supported by sportsmen, gave California a new opportunity to catch up with losses to wildlife management sustained during World War II by providing additional dollars for fish and game.

W. C. B. Help Invaluable

The Wildlife Conservation Board, which has since spent about $13,000,000 in capital outlay for fish and game production and maintenance facilities, provided an important shot in the arm for California wildlife.

A $1.00 increase in license fees, authorized by the 1947 Legislature, actually was more than absorbed by the increased cost of doing business.

Neither of these aids to wildlife anticipated the tremendous inflation spiral which devalued the new $3.00 license fee to $1.92, nor the continuing overwhelming boom in population creating terrific new pressures on wildlife.

While the number of licenses sold annually increased the number of dollars received by the Fish and Game Preservation Fund, the cost of materials, equipment, salaries and transportation went up at a much faster rate.

Unlike tax revenues based on market values or percentages of income, fixed fees such as hunting and fishing licenses do not provide increased numbers of revenue dollars to Fish and Game in terms of buying power.

At the close of the current biennium it was apparent that the operating reserve fund, which has cushioned the shock of inflation, would soon be gone, and that either it would be necessary to find new sources of revenue or to cut back drastically on the present program.

THE DEER PROBLEM

The continuing failure of California's growing hunter army to harvest a number of deer sufficient to keep animals and range in balance has created a serious problem in practical management of the State's valuable herds.

Under good range conditions the normal, healthy doe will usually have two fawns per year.
(Fish and Game Photo)

Prior to the turn of the century deer were scarce. Unrestricted hunting had reduced the herds to a low level. In the 1880's, however, conditions had begun to change. Logging operations opened up timber stands and allowed an increase in browse species. Fires during this early logging period created interspersed openings in forests, permitting brush fields to grow. On the other hand the depletion of grass cover by overgrazing of cattle and other causes and the consequent reduction in fire occurrence permitted an increase in browse vegetation in juniper, sagebrush, desert shrub and woodland grass areas.

Man Aided

Man also aided the deer by reducing the number of livestock on national forest, federal and privately owned lands, leaving more reserve forage. In some instances homesteaders helped when they broke up vegetation types by clearing brush and trees and then abandoned their sites.

These factors set the stage for return of the deer in large numbers by creating a favorable habitat. Restoration of the herds was further aided when the State instituted a "bucks only" shooting law and developed an efficient force of game wardens and predator trappers.

Today the deer have increased to such abundance that the pendulum has swung the other way; their natural range is not sufficient to support them in a healthy condition.

Deaths from starvation, malnutrition and related diseases have been the lot of far too many deer on overstocked ranges.

Food Quality Declines

Heavy populations over-browse the better forage species. This results in a steady decline in the quality of their food to the point where weaker animals succumb and wasteful losses occur.

Usually fawns and older deer are the first to succumb. Fawns particularly are vulnerable because during the first year of life their energy is spent in growth and they build up little reserve of fat. Fawns, being smaller, cannot reach the browse on high-limbed shrubs and trees, whereas larger animals can.

The lack of natural forage often causes other troubles. Forced to look elsewhere for their food, deer sometimes seek it in nearby orchards, alfalfa and hay lands and other places, thereby causing damage to the property and crops of farmers who live on the fringes of deer ranges.

Bigger Harvest Desirable

Estimated to be well in excess of 1,000,000 deer, the California herds produce an annual crop of at least 200,000 animals for harvest each fall. Hunters took 75,602 bucks in 1954, the record year since deer tags were instituted in 1927. In 1955, the bag was 71,126. Despite these two high years, the average kill over the last 24 years has been a meager 38,775 annually. Thus the harvest has been much less than it could have been, and Nature took the balance in her own cruel way.

Department biologists, big game experts from the University of California, from the U. S. Fish and Wildlife Service and from agencies of other states all agree that under proper management hunters not only can shoot 200,000 animals per year safely in California, but that the annual harvest must be very close to this amount if the herds are to flourish.

Deer Policy

The answer to the deer problem is contained in a policy established in June, 1950, by the California Fish and Game Commission after state-wide discussion and approval by sportsmen, ranchers, conserva-

"Training the trainers." First group of top level supervisors and staff officers attends a training program class.
(Fish and Game Photo)

tion agencies and other interested parties. Simply stated, the policy is to maintain the herds at their range-carrying capacity by harvesting surplus deer of either sex.

The first antlerless hunt, which was to set the pattern for subsequent hunts, had been held in the winter of 1949-50. Others followed as the recognition of deer problems became more general. Since the first hunt there have been 37 special hunts, 20 of which occurred in the last two years. These hunts led to the establishment by the commission in May, 1956, of the first general antlerless seasons in 34 counties, scheduled in the fall of 1956.

Guide for Future

When regulations for the first either sex hunting season were under consideration, the Fish and Game Commission pointed out that experience gained from the 1956 season would serve as a guide for future hunts.

Experience would determine whether future hunts would be longer or shorter, whether either sex hunting would extend throughout the season or be more limited, whether future hunts would be on a quota system in various sections of the State to control the kill of deer, and whether it would be necessary to ask the Legislature for power to control hunter concentrations in specific areas.

POLLUTION

During the biennium there was a considerable shift in the department's pollution problems—from fresh water to salt water.

Preliminary evidence indicated that pollution of ocean and bay waters by sewage and industrial wastes is having a widespread, harmful effect on fish life, although extensive studies are still needed to evaluate this problem and determine what corrective measures need be taken. There seems little doubt that the sewage flow from increasing growth, particularly in Southern California, has reached the point where there is no longer adequate dilution in the coastal waters and additional treatment facilities are needed, particularly in the San Diego and Los Angeles areas.

The point has been reached where it has become both feasible and necessary to highly treat and re-use much of the waste waters in Southern California. This will help to solve the serious water supply problem and will also provide needed protection for fish and aquatic resources of the area.

Beaches in Danger

The beaches and coastal waters of Southern California are an invaluable part of Southern California's way of life, and courageous steps must be taken without delay to prevent extensive damage to sport and commercial fisheries, as well as to the recreational potential of the beaches.

Warden Ed Johnson checks the license of Angler Bill Frunell of Sacramento while on routine patrol in El Dorado County.
(Fish and Game Photo)

There has been an increasing emphasis during the biennium on the biological phases of California's water pollution program. In two cases, new industries moving into the State, have retained consulting biologists to make complete evaluations of conditions in nearby receiving waters before building new plants.

In the case of the City of Los Angeles and the Santa Monica Bay sewage discharge, the State Water Pollution Control Board ordered a policing program to actually test the toxicity of the discharge. This will make possible an evaluation of the effects of the discharge and will provide the advance warning needed in order that further corrective measures can be taken long before conditions in the receiving waters become critical.

DEPARTMENTAL

Establishment of an in-service training program designed to improve the quality of departmental services by increasing the effectiveness of employees highlighted departmental organizational activities during the biennium.

The first scheduled training under the new program was a two-day course for regional managers and staff officers held in Sacramento in early 1955. At this time final plans were also made for inaugurating department-wide training for all employees.

The in-service program, developed within the framework of the state training policy, consisted of orientation training for new employees and continuing refresher training for all employees.

Operational Manual

Work was started in February, 1955 on a manual detailing uniform operational and administrative procedures for statewide use by department employees.

The manual is designed to provide specific information on problems relating to management and operation and is to serve as a comprehensive reference source on policies, procedures, regulations and general departmental information.

Complete, up-to-date copies of the loose-leaf mimeographed manual are being maintained at all major offices and installations of the department.

A streamlining of the supervisory positions at the state fish hatcheries, undertaken in response to the changeover from small fingerling hatcheries to big new multi-crop installations, was completed by the department and the State Personnel Board during the biennium.

The new set-up strengthens supervisory organization and control by splitting the old top supervisory class of Fish Hatchery Foreman into two new classes, Fisheries Manager I and Fisheries Manager II.

WILDLIFE PROTECTION

The growth of California's army of sportsmen has more than kept pace with the over-all population growth of the State in the postwar period. From July 1, 1948, to the close of the current biennium, the State has grown by 31 percent, whereas the numbers of sportsmen buying fishing and hunting licenses increased by 32 percent from July 1, 1948 through 1955.

The problems created for the department's law enforcement branch by the increased hunting and fishing pressure have been manifold, particularly since there had been no increase in the warden force for many years. The last addition was in the 1948-49 Fiscal Year when 32 men were added to the staff.

Studies conducted by the department oboord the reseorch vessel Nautilus *led directly to the enactment of legislation requiring all crab traps (pots) to provide openings to permit undersize crabs to escape. Arrows show four-inch circular openings.*
(Fish and Game Photo by D. W. McFadden)

By the end of the 1955-56 Fiscal Year there was one warden for every 10,392 license buyers. The Department of Finance recommended that the ratio be one for every 7,500. The 1956 Session of the Legislature responded to the request of the Department of Fish and Game by authorizing 30 additional game wardens and six additional game warden captains, bringing the total law enforcement branch to a strength of 253, of which 213 are wardens and the others captains and supervisors. The new men were to begin their duties in the 1956-57 Fiscal Year. At the 1955 figure of 1,938,027 licensed hunters and anglers, this additional force will provide a ratio of one warden to every 8,972 sportsmen.

Ratio to Grow

The ratio will undoubtedly soon be greater, however, since indications at the close of the biennium were that license buyers will top the 2,000,000 mark in the next fiscal year for the first time in the State's history.

More sportsmen in the field meant a sizeable increase in the work load of wardens during the biennium. In spite of this, the wildlife protection function was able to report a 15 percent increase in arrests over the 1952-54 period. To achieve this mark, wardens had to put in long hours of overtime work without added compensation.

A Department of Finance report in 1954 estimated that wardens average 12 hours per day in the field. Wardens were called on for cooperative efforts of the department with other state agencies, became area leaders in pheasant co-ops, aided in the stream flow maintenance program, checked fish screens and ladders in routine patrols, aided in fish rescue work, worked on pollution control and fact-finding projects, appeared before public groups, helped in searches for lost persons and cooperated with other agencies during forest fires and other emergencies.

Wardens Helped in Flood

One such emergency was the disastrous floods of the winter of 1955. At least 75 department men contributed efforts above and beyond the call of duty during the period. In some cases wardens were able to give the first alarm of the trouble to come; in others they formed the only communication with the outside world for flood stricken communities.

MARINE FISHERIES

The Marine Fisheries picture was a variegated canvas of some very bright and some very dark hues throughout the biennium. The brightest spots were found in the shellfish fisheries and the darkest in the ocean fisheries, although each contained its opposite patches of dark or bright.

Two record salmon catch years, a revitalized oyster industry, new legislation to protect the market crab

fishery, a burgeoning new shrimp fishery, and establishment of a sport fishery in the Salton Sea were highlights of the period.

On the other hand, there were some very gloomy reports. Continual reproductive failures put the future of the Pismo Clam in question. The sardine catch was slightly higher in the biennium than in the preceding two years, but there is no indication the local fish will return in any numbers like those of the period between 1925 and 1945. Sardines which moved north out of Mexican waters represented the increase in the catch.

Tentative conclusions from pollution studies indicate that various sewer outfalls and industrial waste discharges have caused harm to ocean fishlife.

RECORD SALMON HAUL

Increased hauls of king salmon contributed to a commercial catch of 8,600,000 pounds in 1954, a record that was topped in 1955 with a catch of 9,700,000 pounds. While the commercial catch of kings skyrocketed, the silver salmon haul went into a slow decline.

For the first time since 1952, when netting restrictions were placed in effect, river commercial fishermen in 1955 landed in excess of 1,000,000 pounds of salmon. A change in commercial river gillnet gear in the Sacramento River accounted for their increase. During the biennium Marine Fisheries personnel were concluding studies to determine the importance of Sacramento River kings to the coastwise salmon industry. They found that a change in the producing potential of one state affects the salmon fisheries of other states, and is a factor to be considered in conservation programs of the entire Pacific coastal region.

A species of salmon new to California, the Pink, appeared for the first time off the California coast in 1953, and was taken in substantial commercial numbers for the first time in 1955 when 2,000 were landed from Monterey to Crescent City. The Pinks were observed spawning in the American River in 1955.

The return of the oyster to a place of importance in the commercial catch of the State reflects credit upon wise conservation practices recommended by the department and enforced by the Legislature, upon modern farming methods instituted by oyster culturists, and upon physical conditions highly conducive to successful oystering.

Unfortunately, the areas in which oysters may be planted successfully is limited to those presently in production. Many thousands of acres of the State's bays would be suitable for oyster culture, but are now polluted by waste disposal.

CHANGE IN CRAB LAWS

Steady decline in the catch of market crabs from a high of 12,941,418 pounds in 1952 resulted in a change in crab laws in 1955 and a request by the Legislature for additional information to improve the fishery. A shortening of the crab season and the establishment of a fixed opening in crab pots to give the smaller crabs a chance to escape were placed in effect in 1955 by the Legislature. While it is too soon to assess the effect that these conservation measures have had upon the fishery, there were signs that 1956 would be a record year for the commercial crab men.

Landings in the Eureka-Crescent City area in 1956 were nearly five times the 1,500,000 pounds recorded in 1955, and may push the state-wide catch close to the record of 13,000,000 pounds established in 1952.

Limits of ducks taken at Imperial Waterfowl Management Area are displayed by Robert Redline of El Monte (left) and Tam Souders of South San Gabriel.

(Fish and Game Photo)

NEW SHRIMP FISHERY

A direct result of work of the Marine Fisheries Branch has been the establishment of a new industry which shows every sign of a healthy, vigorous future. Continuing research and exploration by the department uncovered the possibility of a shrimp fishery in California waters. In 1952 commercial fishermen were interested enough to net 206,000 pounds. In two years this figure grew to 300,000 and in 1955 to 855,000 pounds. Through June 30, 1956, a total haul of 419,000 pounds, an increase of more than 20 percent over a similar period in 1955, was recorded. The Crescent City shrimp fleet contributed 308,000 pounds to the total, followed by the Bodega Bay fleet with 111,000

pounds. Further research is continuing in the efforts of Marine Fisheries workers to expand this industry.

SALTON SEA

Sports fishermen in the southern part of the State should benefit soon from efforts of the department to establish a sport fishery in the Salton Sea. An estimated 100,000 corvina, the descendants of fish planted there by the department, have successfully spawned and biologists look for a continually expanding population. A study of this inland sea, begun in 1954, has revealed that it has a life expectancy of at least 30 to 40 years as a sports fishery under conditions that now exist.

PISMO CLAM

Fears that the Pismo Clam may be on its way down formed one of the clouds that cast a shadow on the overall Marine Fisheries picture. The popular shoreline delicacy just hasn't reproduced as it should. The years 1944 at Morro Bay and 1947 at Pismo Beach were the last times the Pismo Clam has produced "sets" in numbers considered sufficient to sustain the fishery. The cause may be the result of a combination of many factors. Investigation is under way, but conclusions have not been reached.

GAME MANAGEMENT

In spite of a record two-year deer bag, it was apparent at the close of the biennium that Californians were taking only a token harvest of their most valuable big game resource. The record year was 1954 when 75,602 bucks were taken by hunters. This fell off slightly to 71,126 in 1955 for a two-year average of 73,374 bucks, far above the 29-year average of 39,782, but far below the annual reproduction factors of 250-300,000 fawns.

One area in the State has shown a constant increase in harvest. This is the Barton's Flat area of Fresno and Tulare Counties where both sexes have been thoroughly harvested under special hunting seasons since 1952. Within this area, the buck harvest during the regular season has increased each year from 208 in 1952 to 334 in 1955.

One of the most serious problems encountered by the department has been access by the hunter to lands where game species are found. In an effort to relieve this problem, hunting arrangements have been worked out on certain parcels of private land, such as the Tejon Ranch and San Emidio Ranch areas of Kern County.

WITHDRAWAL OF LANDS

Public domain lands have been examined, and large blocks found to have wildlife potential have been requested for use as hunting and fishing areas. Withdrawal applications, approved by the Fish and Game Commission and filed with the U. S. Department of the Interior, totalled more than a half million acres at the close of the biennium. Approximately 40 miles of access roads were constructed to open up public lands for hunters.

First open season on the wily chukar partridge, introduced by the department in the semi-arid areas of the State, was held in 1954.
(Fish and Game Photo)

Acquisition of the Mendota Waterfowl Management Area and purchase of additional acreage for Gray Lodge and Imperial, expanded state-managed areas by more than 15,000 acres to a total of 47,198. Another 2,887 acres in the San Luis Wasteway is under lease by the department. Significantly, the 1954-56 biennium witnessed an all-time low in waterfowl depredation. This is particularly noticeable in the Grasslands area near Fresno. Acquisition and development of the Mendota area and a cooperative program between rice growers, duck club owners, U. S. Fish and Wildlife Service, and the Department of Fish and Game, wherein several thousand acres of duck club lands are flooded during the crop depredation period, has substantially reduced crop damage.

COOT PROBLEM

The solution to the coot problem has not been as simple, however, as efforts to herd the birds away from crops have not met with success. Despite the fact that the coot is a popular game bird in certain other flyways in the east, California hunters have refused to recognize this bird as a desirable target. Thus, the species has been virtually unharvested. The result has been that large populations of birds not only have damaged crops but have competed for food with other waterfowl.

During the late winter of 1954 and 1955 the taking of coots was made legal through a Depredation Control Order of the U. S. Fish and Wildlife Service. In an attempt to reduce the depredation problem and to teach the hunters the sporting potential of the bird, an intensive educational program was carried on by the U. S. Fish and Wildlife Service and the depart-

ment, and a considerable effort was made to interest hunters in areas where large populations of coots presented problems.

During 1954 it was difficult to generate any interest among the hunters, but during the second opening in 1955 interest in the bird was increasing. The campaign continues, and it is possible that eventually this bird may become a valuable resource instead of a nuisance.

Upland game hunters found conditions better than ever during the biennium. The quail bag in the 1954 season was above normal, but poor hunting weather was the big factor in a below-normal 1955 season. Otherwise, the shotgun hunters had a fine time. Near record takes of doves, which run a close second to ducks for popularity among sportsmen, occurred during both years.

PHEASANT BAG INCREASED

Total bag of pheasants increased nearly 25 percent, largely because of liberalized regulations which lengthened the season from 10 to 16 days and permitted the taking of one hen in the seasonal bag limit for the first time. Also for the first time, pheasant hunting was permitted on weekends on federally owned waterfowl lands.

While the pigeon take was below normal, the blame should be placed on poor distribution of the birds and not on a decrease in the population. The 1955 nesting period was above average.

Upland game enthusiasts found another target during the period with the introduction in arid areas of the chukar partridge. Installation of guzzlers has created a habitat for this new game bird, which is reproducing well and should provide good sport in numbers for Southern California hunters. Two open seasons were held during the biennium and a third was authorized, to coincide with the 1956 quail season in chukar areas.

Fish screen at Tracy Pumping Plant of Delta Mendoto Canal on San Joaquin River.

(Fish and Game Photo)

INLAND FISHERIES

California's growing population and its ever-increasing interest in outdoor activities have been felt in the department most strongly by the Inland Fisheries Branch.

Angling license sales have jumped 235 percent in only 15 years, from a prewar figure of 390,342 fishermen to 1,302,927 in 1955. In five-year increments, the number of anglers went up 42 percent by 1945, up a whopping 76 percent in the five-year period following the end of the war, and it jumped 43 percent in the next five years. Currently, the annual trend is an increase of 5 percent, with no end in sight to the postwar boom that has just about doubled California's population in 10 years.

The steadily mounting demand for fishing, as reflected in license sales, has resulted in stepped-up activity in all of the department's fish-increasing programs.

More fishing opportunities were created by two Wildlife Conservation Board programs. One is concerned with opening formerly inaccessible areas by providing access sites, and the other is the warm-water fisheries program.

The department's continuing program of habitat improvement has created still more fishing opportunities for the sportsman. Protection of existing fisheries occupied considerable attention during the biennium. The department continued its efforts to establish screens and ladders on important streams and stepped up its investigation of new water projects and the growing pollution problem.

TRACY FISH SCREEN

The Tracy Fish Conservation Facility, which embodies a new concept in fish screening, was completed. The department cooperated fully in the project. The structure was built by the U. S. Bureau of Reclamation at a cost of about $2,000,000 after research had shown the desirability of saving millions of small striped bass and salmon which would otherwise be lost. The tiny fish, which drift with the current, tail downstream, seem to sense obstructions in their way and are able to avoid them. With this knowledge, engineers designed a vertical system of louvres which the fish avoid by means of their built-in "radar" and thus pass along the obstructions into a safe diversion channel.

Construction of new screens and replacement of older screens either in need of repair or obsolete because of changing conditions kept the screen shops at Elk Grove, Red Bluff, and Yreka working at capacity.

Spraying fish toxicant in treatment of City of San Diego's Lake Hodges to remove over-population of carp.
(Fish and Game Photo)

The extremely heavy floods of December, 1955, created more than $100,000 in damage to hatcheries, fish screens and ladders essential for the protection of the State's steelhead and salmon.

WARMWATER FISHERIES

Early in 1954 the Wildlife Conservation Board assigned its highest priority to development of warmwater fisheries by placing a hydraulic engineer full time on the job of investigating possible projects. More than a dozen projects, of several hundred investigated, were presented to the board for its consideration.

The program is directed toward utilization of existing impoundments, access to other existing impoundments, and creation of new impoundments.

By means of dredging, weed control, and construction of parking areas, boat ramps, or other access devices, 15 lakes with a total area of 14,361 acres have been acquired or developed, or are in the process of being acquired or developed (completed, 3,830 acres; under way, 4,194 acres; planned, 6,337 acres). One is a trout lake and 14 are warmwater lakes. These lakes were formerly either closed to fishing or unsuitable because of shallowness or lack of access. Nine public angler access sites totaling 109 acres were acquired and 20 others averaging five acres each are in the planning state. Most of them are located along the Sacramento River and in the Delta region.

HATCHERY PRODUCTION INCREASED

A consolidation of the hatchery program has resulted in more efficient production, and a change in planting policy by the commission has increased the size of catchable trout.

In 1955 the number of catchable trout dropped slightly from the previous year to 7,585,000 but the weight increased to a new all-time high of 1,240,576 pounds. The weight increase is partially due to a late 1955 policy change by the Fish and Game Commission which increased the planting size range of catchables from 6-8 per pound to 4-6 per pound. A total of 18,000,000 fingerling trout and salmon weighing 85,000 pounds was planted, nearly doubling the previous year's fingerling production.

ROUGH FISH CONTROL WORK

Heavy emphasis was placed on control of rough fish populations through use of chemicals. The Russian River, and the entire drainage of Putah Creek were treated to reduce rough fish. The Russian River project was the largest chemical treatment program ever undertaken on a river system. A total of 286 miles of stream was treated to eradicate squawfish, suckers, roach, and carp, and thus improve conditions for natural reproduction of steelhead; and 57 lakes, comprising 11,447 surface acres, were treated for the same purpose. At the end of the biennium, the rough fish appeared to be making a comeback, but were still not up to their former numbers. Meanwhile, summer trout fishing greatly improved after the treatment of November, 1954.

San Diego Reservoir

A "California first" was marked up on January 31, 1956, when the City of San Diego chemically treated Hodges Reservoir with fish toxicant. More than 100 tons of carp were removed from this domestic water supply reservoir and the fish kill was believed complete.

No similar project involving a large supply of potable water had been attempted heretofore in California. The project succeeded in improving both water quality and conditions for a sport fishery. San Diego is one of the few cities that has long permitted fishing in its domestic water supply and the success of the San Diego program is of far-reaching importance to anglers all over the State.

Other major habitat improvement work consisted of the construction of a large number of pool-creating devices in some of the smaller streams and flow maintenance dams throughout the State. A new rock-masonry flow accelerating structure, an improvement over the log and rock dams and deflectors tried in 1953-54, was developed and installed on some Southern California streams.

CONSERVATION EDUCATION

Major efforts were exerted by the Conservation Education Section to increase public understanding and acceptance of sound deer management practices; prevention of damage to streams by logging operations; and the complicated effects of water development on California fish and wildlife.

With licensed sportsmen most specifically concerned, and additional millions of people also vitally

Conservation education covers many phases of wildlife management and calls for varied approaches.
(Fish and Game Photo)

interested in the welfare of their wildlife resources, every public media in the State was provided with information and educational materials on these subjects of vital importance.

Approximately 8,000,000 pieces of mimeographed or printed material, half of which were angling and hunting regulation abstracts, were made available to the public upon request during the biennium.

Hundreds of public schools which requested information on wildlife were also provided materials available.

Working with the Interdepartmental Committee on Conservation Education, Fish and Game supported various efforts to improve wildlife conservation materials available to the schools from various sources, and to seek ways of expanding and improving conservation education training available to student teachers in various state colleges.

HANDBOOK SERIES

Specifically designed as a guide to school teachers was the Home and Hunter Safety Training handbook produced cooperatively by the Departments of Fish and Game and Education. A series of handbooks, designed for future use as supplemental classroom material, also was undertaken by Fish and Game. The first two handbooks, Waterfowl of California, and Upland Game of California, had their preliminary printings while Big Game of California and Trout of California were in production. These handbooks were to be offered for sale at cost to California schools for the 1957 school year.

A number of school districts purchased copies for local use of several of the department's motion pictures on wildlife subjects during the biennium, and scores of schools borrowed loan copies of these films for short periods.

As a service unit of the department, the Conservation Education Section handled an increasing load of requests for all kinds of information concerning wildlife. Methods for collecting the basic information from department personnel throughout the State were improved, while economies were effected in producing and disseminating such information to the public, schools and public media.

Special requests for information and photographs from authors, legislative committees and other agencies of government numbering more than 100 were handled by the section.

A series of anglers' guides, designed to interest fishermen in high-mountain areas where the trout are now under-utilized, was expanded. Purpose of such guides is to bring about more extensive use of trout which maintain themselves at small or no cost to the department and to thus relieve some of the fishing pressure on more accessible waters where hatchery-raised trout are planted by the department.

TELEVISION, RADIO, MOVIES

Approximately 200 radio stations were regularly serviced with information on fish and game matters. In cooperation with department personnel, the section assisted in the airing of about 75 "live" radio and television shows.

Personnel also cooperated with program directors in planning television shows, obtaining the services of department personnel and visual material for use on such shows. In some cases Conservation Education personnel appeared on shows in person, along with local leaders or instructors, particularly on programs explaining the new hunter safety training program.

Nearly 3,000,000 people viewed the department's two new and five revised wildlife conservation movies during the biennium and another 48,460 saw the three hunter safety films. The seven movies were shown to an authenticated audience of 155,939, comprised mainly of school students, conservation club members, and members of fraternal, social, civic and service organizations. The films were also shown on television to an estimated audience of 2,603,500 viewers.

In addition to regular duties, Conservation Education personnel handled special problems during the biennium. The hunter safety training program, the in-service training program and the logging pollution problem were chief among these.

HUNTER SAFETY

On July 1, 1954, a new law required that youths under 16 could not obtain a hunting license before completing a minimum four-hour course in the safe handling of guns. Since the law went into effect a total of 41,740 juniors attended classes set up by the Conservation Education Section's hunter safety training program, which was spearheaded in the field by the wardens. A total of 4,654 adults were certified as volunteer instructors, through cooperation of the National Rifle Association. Much of the load of teaching was shouldered by reserve wardens, school teachers,

Somewhere under this pile of logs and slash is Hunter Creek. Careless logging practices have rendered this stream useless for spawning.
(Fish and Game Photo)

sportsmen's organizations, and other volunteers. California's instructors made up nearly half the number certified by the NRA to teach such courses in the United States.

Outstanding Record

Only two trained junior hunters were involved as shooters in accidents during the 1955 hunting season, which was the first full opportunity to view the results of the training program. Including a junior hunter victim of an unidentified shooter, the casualty rate among the trained junior hunters was only 1 in 11,000.

Of the some 9,000 untrained junior hunters afield in 1955 (who previously held licenses and were not required to take the safety course), 14 were involved in casualties, of which four were fatal shootings. The casualty rate among untrained juniors was one to every 650 untrained junior hunters afield. The trained junior was almost 17 times as safe as his untrained counterpart, and nearly twice as safe as the adult hunter.

A study of hunter casualty reports indicated that they were occurring not only because of careless gun handling but also because of some visual deficiency on the part of the shooter. This led to participation by the department in laboratory and field tests of visual acuity, particularly in regard to visibility of various colors of clothing under hunting conditions. The department cooperated with the National Rifle Association and the California Optometric Association in setting up and carrying out the tests. Preliminary results indicated that the traditional red is not as readily discernible in the field as many other colors, and that yellow may be the easiest color to spot.

IN-SERVICE TRAINING

Under the direction of the Conservation Education Section, a department-wide in-service training program was organized during the biennium. The program provides new employees with basic orientation training and offers functional on-the-job training as well as cross-functional training in all activities of the agency. With the organization and much of the content of the training program completed, responsibility for the program was to be transferred from this section to the personnel section in the next biennium.

The program got under way in late November, 1954, with the appointment of a full time training officer. Preliminary groundwork included establishing contacts with cooperating agencies such as the State Personnel Board Training Division and the Department of Education, collecting a basic training library and making a review and report of post-training activities.

Training the Trainers

The program was inaugurated in three phases. First was the "train the trainers" phase, in which top level supervisors, in four groups of 10 each, were given a 72-hour course. This was followed by 48-hour versions of the same course given in the regions to second line supervisors who had taken the 72-hour course. First line supervisors were the students in the third phase. Leaders were supervisors who had been trained in the first two steps.

The training policy is to provide the opportunity for maximum development of the capabilities of all employees so they may progress individually and to provide for maximum efficiency within the department. The training policy also includes emphasis on the importance of the employee's relationship with the general public.

LOGGING POLLUTION

Special efforts were made during the period to make known to members of the logging industry the serious effects on fish life in Northern California streams resulting from careless logging practices. A survey showed 925 miles of steelhead and salmon spawning streams were lost by logging, slash and silting pollution, or by removal or destruction of riparian vegetation.

Proceeding on the thesis that an informed public is the best guarantee of good conservation practices, this section inaugurated a series of bulletins designed to inform the logging industry of the needs of fish life. Three bulletins were published and a fourth was under production. These were augmented by direct contacts with industry leaders. The program was coordinated with law enforcement activities and public meeting presentations. A start was made on a motion picture on the subject and at the close of the biennium the program was beginning to show results in the prevention of further damage and in the cleaning up of debris filled streams by logging operators.

WILDLIFE CONSERVATION BOARD

Finnon Reservoir, El Dorado County, purchased by Wildlife Conservation Board funds and to be dedicated exclusively to angling.
(Fish and Game Photo)

Taking stock of California's dwindling natural resources, and cognizant of the necessity to provide for future recreational needs, the 1947 Legislature created the Wildlife Conservation Board and charged it with the task of establishing "a coordinated and balanced program resulting in the maximum revival of wildlife * * * and in the maximum recreational advantages to the people."

To finance this program, the Legislature appropriated $12,000,000 from horse racing pari-mutuel funds. Since 1947 the board has administered this fund, with additional legislative grants, for capital outlay projects it deems essential and suitable for wildlife production and preservation and which will enhance recreational values. The board, which is responsible only to the Legislature, consists of the President of the Fish and Game Commission, the Director, Department of Fish and Game, and the Director of the Department of Finance. Three members of the Senate and three members of the Assembly serve as an advisory group to the board.

During the first year of this biennium, the Wildlife Conservation Board concentrated on completing projects involving waterfowl management areas and fish hatchery construction. By the end of the second year these two programs were almost completed. Some work remains to be done on Gray Lodge and Imperial Waterfowl Management Areas and minor hatchery capital outlay also may be required.

WARMWATER PROGRAM

The second year of the biennium saw the intensification of the warmwater fish program, and access to inland fishing waters.

The 1955 Legislature approved a recurring annual appropriation of $750,000. The first amount became available July 1, 1955. Those supporting this legislation pointed out that the waterfowl and catchable trout programs were almost fully developed, but that much work was needed to provide suitable warmwater fishing for the ever-increasing population.

A survey revealed a great potential in developing existing reservoirs, including public water supplies, as well as such bodies of waters as dredger ponds, coastal lagoons, sloughs and oxbow lakes. When impounded waters were not available for development, it was proposed to construct new reservoirs for fishing and recreational use.

Public access to fishing waters and public lands is a growing problem and the Wildlife Conservation Board has recognized this by instituting a long-range program of correction. Its three major facets are inland angling access, coastal access and access to public hunting lands.

The board continued its practice of approving only projects which did not burden the Department of Fish and Game with additional operating expenses. The angling access program and the warmwater fish program are the two major programs in this category.

During the biennium 15 new projects, involving a total expenditure of $598,000 were approved. Three were hatchery and stocking projects, seven warmwater and other fish projects, three fell in the fish screen and ladder category and the others were included in the inland access program.

In addition, the board allocated $25,000 for project evaluations, surveys, engineering studies and property appraisals.

Additional allocations, totaling $1,503,000 were made to 19 old projects. Hatchery and stocking projects led the list with six, followed by five flow maintenance and stream improvement jobs, four in the category of warmwater and other fish, three waterfowl projects and one in the coastal angling access program.

Twelve projects were completed during the biennium and three were canceled and funds recovered.

CHANGES OF BOARD MEMBERSHIP

The Joint Legislative Advisory Committee was composed of Senators Charles Brown, Ben Hulse and Ed. C. Johnson, and Assemblymen Frank P. Belotti, Thomas M. Erwin and Lloyd W. Lowrey. Department of Finance Director John M. Pierce and Department of Fish and Game Director Seth Gordon continued to serve on the board. Harley Knox replaced William J. Silva as chairman during the biennium.

E. E. Horn continued as the board's coordinator. Because of the increased workload, the board authorized and the State Personnel Board established the position of assistant coordinator.

ANGLING ACCESS

The Wildlife Conservation Board authorized the hiring of a special consultant to make a field survey of the Sacramento and San Joaquin Rivers and the Delta area and to report on the need for angling access along with a series of suggested access sites. This survey was in progress as the biennium ended.

Two access sites were purchased from the U. S. Bureau of Reclamation. One was a two-acre parcel located along the Sacramento River near Redding. The other consisted of two acres, five miles east of Vina on Deer Creek in Tehama County.

As the biennium closed, a number of angling access sites along the Sacramento, Feather and San Joaquin Rivers in the Delta area and along the ocean were being planned for development.

This program was deferred until the major hatchery and waterfowl projects could be completed. It consists largely of constructing fishing access facilities at reservoirs and creating new impoundments where seasonal runoff can be secured. Certain facilities were also necessary to safeguard the public health where municipal water supplies were involved. Operation and maintenance of these projects is planned almost exclusively by counties or cities.

OTHER FISH PROJECTS

On the following projects the board authorized, in addition to land acquisition, such facilities as access roads, parking areas, fishing docks, launching ramps, sanitary facilities and fencing:

San Diego City Reservoirs—San Diego County;
Whittier-Narrows—Los Angeles County;
Santa Margarita Lake—San Luis Obispo County;
Inland Lake—San Bernardino County;
Finnon Reservoir—El Dorado County.

Four projects in this category received additional allocations to complete the development. Construction was completed on Ramer Lake, Imperial County, and was continued on Lindo Lake, San Diego County, and Avocado Lake, Fresno County. The Salton Sea project, a program to establish a fishery in this 225,000-acre body in Imperial County, was continued with encouraging results.

The Los Serranos Warmwater Fisheries Management Station at the Serranos Game Farm near Chino and the Plaskett Meadows Public Fishing Area in Glenn County were approved and construction started.

The Dallas Warner warmwater fishing project received no new allocations but work was completed during this period.

Stream Flow Maintenance

The stream improvement program in Southern California was continued. This allocation was made after a survey revealed these small impoundments provide exceptional fishing.

Allocations were made to continue the highly successful stream flow maintenance program in El Dorado and Alpine Counties within the El Dorado National Forest. A similar program carried on within the Tahoe National Forest in Nevada, Placer and El Dorado Counties likewise received an additional allocation.

The stream flow maintenance program was continued in the Emigrant Basin area in the Stanislaus National Forest and in the Granite Creek Basin of the Sierra National Forest through additional fund allocations.

During this biennium four projects were completed. They were the Dry Lake Level Maintenance, Twin Lakes Level Maintenance, Hume Lake Dam Level Maintenance and the San Diego Flow Maintenance Projects.

Although the stream flow maintenance and improvement program met with considerable success, it was becoming increasingly difficult in some areas to locate adequate and economically feasible small dam sites.

(Continued on page 46)

WATER PROJECTS

Artist's conception of Oroville Dam, key unit in the California Water Plan.
(Department of Water Resources Photo from drawing by Warren S. Ludlow of the Division of Highways)

Unprecedented demands for water throughout the State has kept the department hustling during the biennium to preserve and protect streams for fishing while simultaneously exploring the fish production possibilities of existing impoundments and future man-made lakes for recreation.

Activities ranged from investigations of applications for water use permits, of which there were more than one per day during the period, to construction of small dams to insure maintenance of stream flow.

The vital need for legislation to reserve water for fish, wildlife and recreation, in accordance with the policy adopted by the Fish and Game Commission, was stressed by the department whenever the occasion presented itself.

The Department of Water Resources supported this position in early 1956 when it announced it would ask the Legislature to enact measures "for the full implementation of the California Water Plan," including "provisions authorizing the maintenance of live stream flow in the interest of fish, wildlife and recreation as a beneficial use of water."

RECREATIONAL WATERS

The opening of domestic water supply reservoirs for recreational use is another subject which received a great deal of attention.

The department has encouraged fishing on water supply reservoirs under the regulations of the State Department of Public Health which insure that the sanitary quality of the water is not adversely affected. The Wildlife Conservation Board has done much to encourage the opening of previously closed reservoirs by allocating funds for recreation development.

An attempt was made by the 1955 Legislature to pave the way toward making public fishing on reservoirs possible, but it failed to become law.

Nevertheless, substantial advances were made in this phase of the water program. At the end of the biennium it was apparent that directors of many water districts were no longer turning deaf ears on proposals to open their impoundments to fishing; in fact, many were looking on such proposals with considerable interest. And the Department of Public Health was developing a new policy and criteria for recreational use of water supply reservoirs.

UPPER FEATHER RIVER

In April, 1955, the Department of Fish and Game completed its portion of the Division (now Department) of Water Resources' report on the development of the upper Feather River service area.

In the report, the construction of five small reservoirs in the upper watershed was recommended as a part of the Feather River project. These reservoirs would be built to develop the recreation and fishing potential of this area. They would be operated for stream flow maintenance in the north and middle forks and would be used specifically for recreational purposes.

The 1956 Legislature appropriated funds for acquiring the dam sites and for detailed planning of these reservoirs. This was the first time the State had recommended the construction of upstream dams for recreational purposes.

FOLSOM PROJECT

The single biggest water project completed during the biennium was the United States Bureau of Reclamation's Folsom project on the American River near Sacramento. This large multipurpose dam and power plant was completed in 1955 and created a number of problems for the department.

Construction cut off a major portion of the spawning area for salmon and steelhead of the American River. On facts developed by the department and on river basin studies, it was necessary for the Bureau of Reclamation to construct a large hatchery below the dam to preserve these runs. This hatchery is operated by the department, but all costs are paid by the Bureau of Reclamation.

Another problem has been to develop the fishing and recreational potential of the reservoir. The recreational facilities were not built at the same time as the dam and it was necessary for the Legislature to appropriate funds for the recreational development in 1956. The fisheries will be managed by the department while the facilities will be managed by the Division of Beaches and Parks.

TRINITY RIVER PROJECT

The largest water development project authorized during the biennium was the Trinity River Project of the U. S. Bureau of Reclamation. Plans call for a large dam on the Trinity River near Lewistown to divert the flow of the Trinity River into the Sacramento Valley through a series of power plants. The dam will cut off most of the spawning areas of the Trinity River salmon and steelhead.

The department was particularly concerned that the project be planned to maintain the fisheries, and that the plans include a large hatchery to replace the spawning areas cut off by the dam, as well as to maintain adequate flows below the dam for the preservation of fish life.

Authorization Act Unique

The authorization act for the project was approved by the President on August 12, 1955. This act was unique in that the Secretary of Interior was specifically directed to adopt appropriate measures to insure the preservation and propagation of fish life, including definite flow releases in the Trinity River and Clear Creek.

The project is now under construction and the Department of Fish and Game, together with the U. S. Fish and Wildlife Service, has been carrying out extensive studies to determine the size of the runs that will be affected in order to design properly hatchery facilities and trapping facilities that will be required to protect fish life during the construction period of the project.

The U. S. Bureau of Reclamation, the U. S. Fish and Wildlife Service and the Department of Fish and Game have reached substantial agreement on the measures to be taken to preserve the salmon and steelhead of the Trinity River.

Bureau Pays Costs

As in the case of the Folsom Project, the facilities will be operated by the deparrment but all costs will be paid by the bureau as a part of the cost of the whole Trinity River Project. Even though the dam will not be completed for perhaps five years, it will be necessary to have the fish salvage and hatchery facilities completed by 1960. The department is now drawing plans for these facilities. The fish will be trapped and transported to spawning areas up river beyond the consrruction sites in the meanwhile.

OTHER PROJECTS

Most of the major water use projects affecting important sport and commercial fisheries were being processed in Sacramento, Region II, through the steps of obtaining water rights from the State Water Rights Board, Federal Power Commission licenses, congressional authorization, or other types of approval.

More than 1,000 applications for water permits on waters within the State were filed during the biennium. Nineteen applications went to the Federal Power Commission for preliminary permits or licenses for power projects. Over 50 applications were made

Department personnel take salmon and steelhead census of Trinity River to determine spawning potential of the stream in order to estimate hatchery needs when Trinity River Project is completed.

(Fish and Game Photo by Phil Pister)

for permits from the Division of Water Resources to construct dams and 35 reports were received on proposed water development plans by state and federal agencies. All of these were reviewed and their probable effects on fish, wildlife and recreational resources analyzed. In most cases recommendations for protection of these resources were compiled and submitted to the construction agencies.

A total of 167 separate field investigations of water applications were made and 92 were protested by the department. Efforts to obtain data on angler use on streams involved in proposed use projects were intensified by conducting creel checks, ground and aerial car counts and by use of written questionnaires.

Throughout the biennium, close cooperation has prevailed with the U. S. Fish and Wildlife Service and U. S. Forest Service on water projects work. Department efforts have been coordinated with these conservation agencies in a mutually beneficial manner.

The following were the water hearings and projects in which department personnel were involved during the biennium.

MOKELUMNE RIVER

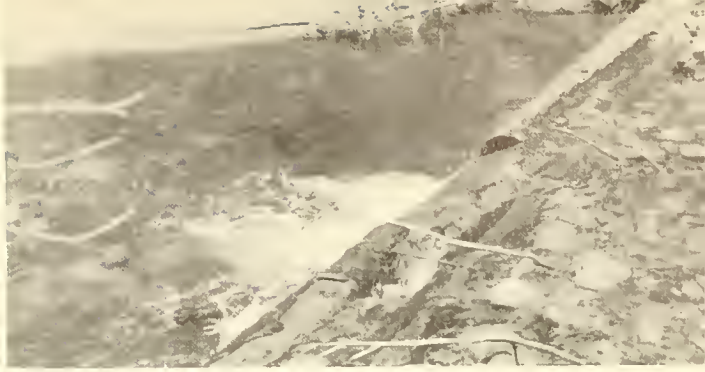
This water rights hearing was conducted by the Division of Water Resources for the purpose of ruling on applications of water from the Mokelumne River by the East Bay Municipal Utilities District, North San Joaquin Irrigation District, and the Calaveras County Water District. The hearings started in October, 1955, and terminated May 2, 1956, with several recesses during the period.

The extensive and valuable salmon spawning beds of the Mokelumne River, as well as several good trout streams, were at stake in the proceedings. The plans of E. B. M. U. D. and N. S. J. I. D. included dams which would inundate and make inaccessible 80 percent of the salmon spawning beds. Department personnel presented oral testimony and written evidence at the hearing in support of its protests to the water applications as filed.

A comprehensive report analyzing the applicants' proposed projects and their effects on the fisheries was compiled and two supplementary written statements were prepared with the aid of the Attorney General's office.

Releases Required

The decision on the water applications rendered by the State Engineer granted water permits to the East Bay Municipal Utility District. These permits contained clauses requiring releases of water for fish from one point of diversion and called for the district and the department to reach agreement on measures to protect the salmon and steelhead resources prior to construction of any dams. The clauses further provide for future determination if agreement cannot be reached.



Experimental stream improvement structure constructed on the South Fork Mokelumne River.
(Fish and Game Photo by John Westgate)

Sportsmen and commercial fishing interests made presentations in support of the department at the hearing.

WASHOE PROJECT

Reviewing changing plans for this Bureau of Reclamation project on the Truckee River and Carson River drainages in California has been a continuing activity since 1949.

Authorizing legislation was submitted in both the House and Senate in 1955. Senate and House subcommittee hearings on the bills were held in Reno. Department personnel prepared, or participated in preparation of, statements presented at both hearings. Numerous meetings were held with representatives of the bureau, Nevada Fish and Game Commission, U. S. Fish and Wildlife Service and water use agencies in Nevada in the department's efforts to achieve protection and, wherever possible, improvement of the fisheries resources.

As a result of the combined efforts of the conservation agencies, sportsmen's groups and interested civic groups, the authorizing legislation for the Washoe Project included provisions for $1,200,000 expressly for the enhancement of fisheries resources through construction of a dam on Prosser Creek (to facilitate constant and increased flow releases from the Lake Tahoe Dam into the Truckee River) and also for the construction of a fish hatchery to supply additional fish to the project area.

AMERICAN RIVER

Following several meetings, review of Sacramento Municipal Utility District project plans and field work, substantial agreement was reached with S. M. U. D. on provisions for protection of fish and wildlife resources in connection with the district's Upper American River Project.

Recommendations submitted to the Federal Power Commission by both the department and U. S. Fish and Wildlife Service were subsequently accepted by S. M. U. D. for inclusion in any permit issued to them by the Federal Power Commission.

Throughout the negotiations, S. M. U. D. representatives were very cooperative and the resulting agreement is a big step toward assuring future fish populations and recreation in the project area.

Various plans of the bureau for water development in the upper American River drainage were reviewed and recommendations for protection of fish and wildlife compiled in cooperation with the U. S. Fish and Wildlife Service.

CHUTE CAMP DAM

Following destruction of their American River Head Dam (Chute Camp Dam) by the floods of November, 1950, the Pacific Gas and Electric Company applied for an amendment to its Federal Power Commission license to cover reconstruction of the dam at a slightly different location on the South Fork of the American River in El Dorado County.

No specific flows for maintenance of fish life had ever been established for release below the old dam and the department and the Fish and Wildlife Service recommended that such releases be made.

Negotiations followed field studies made in cooperation with P. G. & E. and a compromise settlement was made.

The company agreed to release a minimum of 10 cubic second feet in the summer and 5 c.f.s. in the winter. An additional clause calling for reconsideration of these flows upon development of upstream water storage was also included in the amended license.

FEATHER RIVER

A 70-page report was prepared for the State Engineer on the fish, wildlife and recreational resources in relation to the reservoir to be created by construction of the Oroville Dam in order to have plans for recreational development ready when work starts.

The report covered fisheries and wildlife aspects of the reservoir on preproject and postproject bases and contained recommendations for fish and wildlife management and recreational use of the reservoir area, including potential access, camping, boat launching and picnicking areas.

Flycasters on South Fork American River, a heavily fished and papular stream.

(Fish and Game Photo)

The Division of Water Resources indicated its willingness to construct a salmon hatchery below Oroville Reservoir as a means of maintaining those portions of salmon runs which normally spawn in or above the project area. Negotiations and preliminary work were carried on to facilitate this plan, but selection of a site and detailed planning had not started during the biennium.

WATER RELEASES

Over the years, the department's efforts to preserve conditions for fish and wildlife has resulted in the establishment of minimum flow releases below many dams and diversions, but little or no effort has been made to assure that these releases were actually being made in the operation of the projects.

A complete record of such releases was compiled and a system of field checking was inaugurated in 1956. Time did not permit complete coverage, but as the system is perfected the department should be able to check out most diversions each year.

In the case of Vermillion Reservoir (Edison Lake), Fresno County, the Southern California Edison Company agreed to a suitable release schedule for Mono Creek. This was incorporated in the license and releases were started by the company. The agreement also provided a 10-cubic-foot-second release in the South Fork of the San Joaquin River below Florence Lake—a stream that had virtually dried up for 30 years. More than 10 miles of an important, heavily-used fishing stream benefit from the release.

GENERAL PROBLEMS

Studies were made on the proposed Terminus and Success Reservoirs, which are flood control and irrigation storage projects in Tulare County. Recommendations are being made for minimum pools which will support fish and wildlife and develop the recreational potential of the reservoirs.

COOPERATIVE FLOW MAINTENANCE

Through the cooperation of the Los Angeles County Flood Control District and other water agencies, two trout streams within minutes of the metropolitan area afforded excellent rainbow fishing this biennium.

Formerly the Big Tujunga and Cogswell Flood Control Reservoirs were drained rapidly after the last spring rains, and the streams below the dams had short-lived fisheries. Under the new plan, a gradual but sustained release will be made, affording several months of additional fishing and excellent stream flows.

RESERVOIR LEVEL MAINTENANCE

One of the major fisheries problems in California is the difficulty of producing satisfactory fishing in the rapidly fluctuating reservoirs characteristic of Cali-

Test seine haul shows bass and sunfish growing rapidly in Puddingstone Reservoir, Los Angeles County, after reservoir had been chemically treated to remove overabundance of carp, then restacked with game fishes.
(Fish and Game Photo)

fornia. In many cases, reservoirs are completely emptied each year—to the detriment of the fish population.

Puddingstone Reservoir in Los Angeles County posed a typical problem, but the County of Los Angeles amended its Flood Control Act to permit retention of a larger minimum pool and arranged to purchase water to maintain the larger pool for recreational use.

Following a chemical treatment to destroy rough fish in October, 1954, the reservoir was stocked with bass, bluegill, red-ear, channel catfish, and threadfin shad. Excellent growth was made by all game fish and it now appears that the threadfin are playing an important forage role. This concept of purchasing water for recreational use is becoming more common in California.

POLLUTION ACTIVITIES

The department has been concerned with the enforcement of pollution control laws for about 30 years, but, with the establishment of the regional water pollution control boards in 1949, its program has shifted from law enforcement to one with more emphasis on the technical investigations of water pollution. This shift has mainly occurred during the biennium.

During the same period most of the fresh water problems have been solved, but salt water pollution problems have become an increasingly important part of the department's water pollution control program.

Sewage disposal to the ocean poses extremely complex problems. The effects of salt water pollution are insidious—there is no wide-scale fish mortality to attract attention. Rather, the environment slowly changes so that the important food and game fishes gradually decrease in numbers until they are no longer able to survive.

Ocean Studies

The department began ocean pollution studies off Southern California during the biennium as a basis for future measure of changing fish populations around sewage outfalls in the Southern California area. The Marine Fisheries Branch, in the spring of 1956, took steps to record conditions as they exist today.

Sixty-nine survey stations were occupied, using otter trawl gear at depths varying from 5 to 25 fathoms in the area lying offshore from Redondo Beach to just north of Point Dume. Each station covered approximately 30 minutes in time and two miles in space.

All fishes and invertebrates taken in this work were examined at the California State Fisheries Laboratory. A record was kept for each species, listing drag number and date, length, weight and sex. Notations were made regarding state of maturity and particularly any abnormalities that were observed.

When changing conditions around sewer outfalls indicate fish life is endangered, the department will be able to assess the amount of change and the degree of danger by comparing these new conditions with those which existed in the spring of 1956.

Double Transplant

To assess the effect of the White Point sewer outfall upon the abalones in the area, a double transplant and tagging operation was carried out. Several hundred black abalones were gathered at Bird Rock and Catalina Harbor, Santa Catalina Island and transported to White Point where they were tagged, weighed, measured and transplanted. A similar transplant of White Point black abalones was made back to Santa Catalina Island.

Evidence from these transplants will determine whether or not the "sick" White Point abalones can survive if removed to an unpolluted area and will demonstrate what effect the waste discharge will have upon healthy individuals from an unpolluted area.

Department studies have shown that a major portion of San Diego Bay is seriously affected by sewage discharges. Sludge deposits have covered a large portion of the bay and aquatic life in these areas is missing. In 1955, much of the bay was quarantined by the State Health Department. Additional sewage treatment is badly needed and the city is proceeding with plans for new disposal facilities.

BIOLOGICAL MONITORING PROGRAM

In the case of the City of Los Angeles, the State Water Pollution Control Board has established requirements to protect the beneficial uses of the waters of Santa Monica Bay. They have imposed a biological monitoring program to continually test the toxicity of the sewage in order to provide the necessary advance warning in order that further corrective measures can be taken long before conditions in the receiving waters become critical.

New disposal facilities are now under construction. They will be a stride forward in preventing damage to the fishery resources of Santa Monica Bay in the vicinity of the sewage disposal facilities. The department has recommended that planning not stop since it will soon be feasible to highly treat and reuse much of the waste water in this area, thus helping solve the water supply problem while giving more protection to coastal waters.

The department is extremely concerned about the possible effects of other sewage and industrial waste

Dark pattern of pollution, caused by pumping waste moterials into stream, clearly shows at this wood products plant on the Sacramento River near Antioch.

(Fish and Game Photo)

discharges in Southern California and San Francisco Bay. Much more work is needed to evaluate the effects of these outfalls before a definite assessment of damage to fish and aquatic life can be made.

New Industries Cooperating

One bright spot has been the attitude of the new industries moving into California. In general they recognize their responsibilities and it is much easier to solve a pollution problem before it starts, than to try to correct a condition that has existed for many years.

During this biennium two large industries have retained consulting biologists to make a complete evaluation of the conditions of the receiving waters before new plants are constructed. In both cases—a Dupont chemical plant at Antioch and a Diamond Match wood products and molded pulp plant at Red Bluff—waste disposal facilities were designed to eliminate any possible hazard to fish and aquatic life before operations started.

MINING POLLUTION

One continuing problem that has come up again in this biennium is the pollution of the upper Sacramento River by copper and zinc during periods when the Sacramento River flow below Shasta Dam was too low to afford sufficient dilution for the toxic water from Spring Creek during periods of high rainoff. Most of the pollution comes from old abandoned mines in the area northwest of Redding. A considerable number of salmon and steelhead fingerlings were killed in the spring of 1955, marking the third time in the department's knowledge this has happened since Shasta Dam was constructed in 1940.

As a result, the Legislature appropriated $20,000 to the Central Valley Regional Water Pollution Control Board for a study of the problem to determine whether there is a feasible solution.

Biologists from the Philadelphia Academy of Sciences were retained to study the problem. They found that Spring Creek is the main source of pollution and that conditions were worse than had been suspected.

The Regional Pollution Control Board has retained a consulting engineering firm to seek a feasible solution. One possibility is the construction of a dam to hold back the waters of Spring Creek during the period of greatest toxicity. The engineers' report has not been completed as yet.

SAMPLING PROGRAM

For some time the department and the State Water Pollution Control Board have been interested in the possibility of establishing a routine biological sampling program to secure background data on streams that may be affected by waste discharges.

Drs. Usinger and Needham of the University of California headed a research project to estimate the cost of a program which would produce significant data. Their report showed that an excessive number of samples would be required to provide significant information on total number of bottom organisms. On the basis of this study, it was concluded that costs of the biological sampling programs that had been proposed would be too high for the results that would be obtained.

This was a case where an expenditure of $5,000 for a research project demonstrated that the program, which would have cost perhaps $30,000 per year, was not feasible.

It was always been difficult for the conservation agencies to secure recognition of the importance of fish and aquatic life particularly in those cases where a relatively large expenditure is necessary to provide the waste treatment facilities needed to protect recreational uses.

SEWAGE DISPOSAL POSITION

A recurrent problem during this biennium has been the desire to dedicate certain waters solely for the disposal of sewage and industrial wastes. The department has continually taken the position that a firm dedication of waters for waste disposal is not realistic in California. Future demands for fishing and recreation will make it necessary to use all the available waters for these purposes.

It is unfortunate that the waters around populated areas which are potentially the most valuable for recreation are the ones most affected by sewage and industrial waste discharges. It is extremely difficult if not impossible to upgrade any area once it has been dedicated for waste disposal.

During this biennium more than 500 applications for waste discharge were filed with the Regional Pollution Control Boards. All of these were investigated by the department and recommendations submitted for the protection of fish and wildlife to the regional boards in all necessary cases. In virtually all cases the regional boards accepted the recommendations of the department.

SALMON AND STEELHEAD

A king salmon passes up a fish ladder at the Anderson-Cottonwood irrigation dam near Redding. (Photo by Mike Hayden)

The most important species affected by the many water developments proposed or under way on the State's streams are the salmon and the steelhead.

Many dam projects would block spawning, migrations to the upper reaches of Northern California streams, and would thus effectively cut the life line that insures natural propagation of the species. Continued insistence by the department on construction of fish ladders, fish hatcheries and other fish-saving devices wherever needed is designed to help minimize losses of these species, which are valuable parts of the State's economic picture.

HIGHLY PRIZED GAME FISH

Sooner or later most of the State's 1,300,000 anglers want to try their hand at catching the big ones. Both the salmon and the steelhead are highly prized game fish of outstanding sporting quality. Fishermen seek salmon mainly in the ocean and in the lower reaches of the State's rivers. Steelhead are taken almost exclusively in fresh water and provide fishing thrills well worth the seeking.

While it has not been possible to obtain precisely the number or weight of salmon and steelhead caught by sports fishermen, department postal card surveys show that these species are caught in substantial numbers. These surveys, while not providing actual figures in all instances, generally do indicate the trends from year to year.

In 1954, a postal card survey provided an estimate of 800,000 salmon taken by anglers in that year. Of these, sportsmen caught approximately three in the ocean to every one in a stream. The steelhead catch in 1954 was estimated at 342,000.

Fishing resorts along the Smith, Klamath and Eel Rivers and other northern streams cater almost exclusively to salmon and steelhead fishermen, and a large number of anglers who frequent resorts on the Sacramento and San Joaquin Rivers also seek these species.

Sport fishing for salmon in the ocean has been growing rapidly for the past several years and there is every indication that the number of anglers participating in the sport will continue to increase.

COMMERCIAL CATCH GREATER

Sportsmen now take almost as many salmon as do commercial fishermen. During the biennium, the commercial ocean salmon catch off California was the greatest on record. Commercial landings in 1954 reached a high of 8,600,000 pounds and were topped in 1955 when 9,700,000 pounds of ocean-caught salmon were landed. The two-year average (9,200,000 pounds) exceeded that of the previous two years by 1,600,000 pounds and topped the previous 10-year (1944-1953) average by 2,500,000 pounds.

Though total salmon landings in the ocean have increased to record heights, landings of silver salmon have continued to drop each year since 1952. Increased landings of king salmon have supported the expanded fishery. (Table 38.) For many years silver salmon contributed about 10 percent by weight to ocean salmon landings in California; in 1954 they contributed 5 percent and in 1955 only 3.5 percent.

River Gill Netting

Commercial gill net salmon landings in the Sacramento River skyrocketed from 900,000 pounds in 1954 to 2,300,000 pounds in 1955. This was 250,000 pounds

greater than the 38-year average of 2,050,000 pounds and marked the first time landings passed the 1,000,000-pound mark since the Legislature enacted restrictions limiting the activity of the commercial river fishery in 1952.

Increased gill net landings in 1955 were made possible by a major change in gear. Nylon webbing for nets almost completely replaced linen webbing, with a result that the nets were lighter, stronger and required much less care. Using nylon, commercial men found they could fish deeper and during stronger tides in Carquinez Straits than with linen nets.

PACIFIC MARINE FISHERIES COMMISSION

The ever mounting pressure on salmon resources is not limited to California waters, since the three Pacific Coast States, Canada and Alaska are interested in the problem.

The work of all five on king and silver salmon research has been coordinated under the Pacific Marine Fisheries Commission. This included a tagging and recovery program involving relatively large salmon, most of them over 20 inches in length. This program alone has already demonstrated that interstate cooperation is necessary if the salmon fisheries are to survive. For example: From 30 to 60 percent of the ocean catch of salmon spawned in the Sacramento River has been made north of the Oregon line.

Obviously, Oregon and Washington conservation measures will affect the fishing pressure on these fish. Conversely, much of California's silver salmon catch comes from fish originating in Oregon streams.

Studies Result in Action

The combined studies showed that the rapidly declining fall runs of king salmon in the Columbia River were being too heavily exploited in the troll fishery from Oregon north. To overcome this effect, the Pacific Marine Fisheries Commission recommended that the king salmon trolling seasons of Oregon and Washington be shortened, the open period to commence April 15th. Formerly the northern season opened on March 15th and extended to October 31st. For the past eight years the California season has been from May 1st to September 20th.

The Oregon Fish Commission and the Washington State Department of Fisheries (both of which had regulatory powers) acted on the above recommendation in time for the 1956 season.

The shortened season in the north has had a secondary effect of reducing the intensity of the ocean fishery on the Sacramento, Klamath, and other runs of California salmon which habitually move into northern waters in numbers.

MARKING PROGRAM

California cooperated in the king salmon marking program during the biennium when the Marine Fisheries Branch completed the first of two operations designed to determine the importance of Sacramento River kings to the coastwide fisheries and to California river fisheries and to show the relationship of the spawning stock to productivity.

In the first phase of the marking program approximately 4,500 marked salmon were recovered out of 470,000 marked and released as fingerlings early in 1950. They were taken as 2, 3, 4 and 5 year-old fish from 1951 through 1954. Recovery crews searched for these marks from California to Alaska under the coordination of the Pacific Marine Fisheries Commission.

Only one marked fish survived to spawn for every three that were caught. Of those caught, two-thirds were landed by ocean commercial trollers. The majority of these troller catches were made off Oregon, Washington, or Vancouver Island, B. C.

The second phase of these experiments began in 1952 and was similar to the first one. Tentative results indicate that less than two-thirds of the second group of fish was caught north of California.

These experiments, coupled with similar ones in Oregon and Washington, have demonstrated that a change in the salmon producing potential of one state can affect the fisheries of other states—a fact of very important significance in the design of conservation and management measures.

CONTINUING INVESTIGATIONS

California's contribution to the increasing knowledge of the life history of the salmon and of sound management practices of the salmon and steelhead fishery has been substantial. Both the Marine Fisheries and the Inland Fisheries Branches of the department have been actively engaged during the biennium in investigating the mysterious ways of these migrants, as well as in management work designed to protect the fisheries.

Standard tools used by the Marine Fisheries Branch in its annual salmon checking operations are spawning stock surveys and sampling of catches.

Spawning Stock Surveys—Annual inventories of salmon spawning stocks are taken to determine the status of the resource and the escapement to the various contributing river systems.

During the fall and winter of 1954-55, nearly 47,000 salmon were examined in the rivers of the central valleys; in 1955-56 over 25,000 were examined.

Salmon and steelhead tagging operations at the Fremont Weir on the Sacramento River near Verona.
(Fish and Game Photo)

Catch Sampling

	1954		1955	
	King	Silver	King	Silver
OCEAN TROLL FISHERY				
No. fish examined	125,969	11,845	167,712	8,132
Percent of catch sampled	16.5		21.8	
Average weight of fish	10.6 lbs.	6.7 lbs.	12.3 lbs.	7.3 lbs.
Percent of landings by weight	95.0	5.0	96.3	3.5
RIVER GILLNET FISHERY				
No. fish examined	7,347		13,704	
Percent of catch sampled	12.8		11.5	
Average weight of fish	15.7 lbs.		19.1 lbs.	
Percent of landings by weight	100		100	

Similar surveys were conducted on key north coast rivers. Here crews examined over 1,000 king salmon and nearly 400 silver salmon for tags and marks during fall and winter of 1954-55. During 1955-56 crews examined 16,000 kings.

From these surveys, and from fyke-net studies which determine the duration and intensity of the downstream migration of young salmon, as well as from counts at fish ladders and other observation points, accurate population estimates are obtained. Many of these estimates remain in the files for years, but when they are needed they are immediately available. The salmon and steelhead fish hatchery at Nimbus on the American River, which was completed and placed in operation during the biennium, was justified entirely on the basis of spawning stock surveys made from 1944 through 1952.

Catch Sampling—This operation supplies basic information concerning the stocks of salmon, their condition, and their relationship in the fishery. It is a census that reveals how the fish are reacting to the fishery and the changes wrought by man and nature.

THREE IMPORTANT STUDIES

During the biennium the department attacked various problems involving salmon and steelhead on three fronts. The Marine Fisheries Branch undertook a study to determine conditions in the ocean salmon sport fishery. The Inland Fisheries Branch divided its efforts on the other two fronts. It conducted one anadromous trout and salmon investigation on north coastal streams and another on the Sacramento and San Joaquin River drainages.

OCEAN STUDY

Financed mainly by federal aid funds, the Marine Fisheries Branch began a study in July, 1954, to determine conditions in the ocean salmon sport fishery. The goals were to learn the numbers and sizes of fish taken, the amount of effort expended in the taking, the estimated value of the fishery, and the relationship of the fishery to the over-all salmon picture. The study is still under way, but some conclusions have been reached.

The investigators found that anglers fishing from party boats and skiffs land most of the sport-caught salmon in the ocean and bays and estuaries; a small part of the catch is made by shore fishermen who fish near river mouths.

Party Boats

Party boats operating out of most California ports take passengers fishing for hire. From San Francisco northward most of them fish almost exclusively for salmon. From Half Moon Bay south to Avila (San Luis Obispo County) party boats fish primarily for rockfish and salmon. The proportion of salmon in the catch varies from port to port and month to month.

Party boat captains are required by law to turn in daily logs of their fishing activities. Logs show the number of passengers and the number and kind of fish caught, and are used to measure quality of fishing from month to month and year to year.

Skiff Fishing

During the past few years there has been a very rapid increase in the amount of ocean sport fishing for salmon from skiffs. Rental facilities have been provided at nearly every small port from Monterey north. This type of fishing is a comparatively new development and its significance in the over-all salmon picture is still under study.

COASTAL STREAMS

The Inland Fisheries Branch began a study in February, 1955, of trout and salmon in coastal streams in response to needs recognized by the department as well as by legislators and sportsmen.

Federal moneys are used to finance the project. Much of the work is performed at the new Cedar Creek Experimental Station on the South Fork of the Eel River, west of U. S. Highway 101 between Garberville and Laytonville.

The objectives of this project are:

1. To determine the survival to the angler and to spawning of artificially propagated steelhead and salmon.
2. To determine the survival to the angler and to spawning of naturally reproduced steelhead and salmon under varying conditions.
3. To measure the reasons for, and extent of, mortality.
4. To test the effects of various management methods, including physical and biological habitat improvement and regulations on these fish and the fisheries.

A sportfishing dock at Noyo Harbor, Fort Bragg. The small boats are typical of those used by salmon fishermen in the ocean.
(Fish and Game Photo by C. H. Meacham)

5. To provide information for evaluating the effects of proposed and existing water developments on salmon and steelhead in the north-coastal portion of the State.

Work Started in 1955

During the biennium the growth of young steelhead at Cedar Creek Station progressed as expected. Marking of approximately 170,000 fish at the station started on December 19, 1955, and continued through December 21st, when torrential rains caused the river to rise over the rearing ponds and wash away all the fish. At that time 75,186 marked steelhead and approximately 90,000 unmarked fish entered the river.

At the close of the biennium approximately 500,000 young steelhead were in the rearing ponds and the losses from the flood had been replaced.

A great deal of time was devoted to getting data on the Trinity River for population estimates. This information was needed in order to make recommendation for facilities to maintain the important salmon and steelhead fisheries in the face of the huge water development project recently begun at this stream.

Flow Measurements

Water flow measurements, in conjunction with gravel analyses, were made to develop methods for determining an optimum flow over a spawning area. These methods are being applied in the Trinity River and will be applied in the Eel River and other coastal streams. Information on optimum water flows is essential, in order to recommend the proper water releases from reservoirs constructed on salmon and steelhead streams.

Fish sampling on Mendocino coastal streams has revealed that the present summer closure on these streams is a sound regulatory measure. This closure is designed to assure a maximum winter fishery for adult steelhead and is serving its purpose well.

SACRAMENTO-SAN JOAQUIN STUDY

The Inland Fisheries Branch began a study in 1953 of the salmon and steelhead of the Sacramento and San Joaquin Rivers, financed mainly by federal funds. The Marine Fisheries Branch, the U. S. Fish and Wildlife Service and sportsmen's organizations have participated in the work, various phases of which were nearing completion at the close of the biennium.

The study has two principal goals. The first is the evaluation of salmon and steelhead losses in the numerous irrigation diversions in the Sacramento and San Joaquin Valleys. Information gathered to date is already being used as a guide to the economic justification of fish screens at various sites, and to set up fish screen priority lists for diversions in which salmon and steelhead are being destroyed.

The second goal is to determine the effectiveness of supplementing natural steelhead production in the Sacramento River system with hatchery-reared fish. Facts obtained will form the basis for a sound management plan for steelhead trout in the upper Sacramento River.

Fish Losses Evaluated

During the previous biennium, work was performed on irrigation diversions along the Sacramento River between Redding and Sacramento. It was found that losses of seaward migrant king salmon fingerlings, though present through most of the irrigation season, were relatively small because most of the young salmon migrate into the Delta before the normal irrigation season gets into full swing in late April and early May.

However, evidence shows that if the irrigation season started earlier, for example in early March, considerable losses would occur. It was also demonstrated that serious losses of adult salmon and steelhead occur at pump intakes lacking trash grids or screens.

Delta Investigation

During the 1955 irrigation season, work was shifted into the San Joaquin Valley and into the Sacramento-San Joaquin River Delta. Here, between the middle of March and the last of May, eight typical large diversions were sampled for fish losses. These diversions included three located along a 43-mile stretch of the San Joaquin River between Stockton and Patterson, four in the Delta between Antioch and Rio Vista, and one on the Mokelumne River near Woodbridge. Losses of fingerling king salmon at irrigation diversions along the San Joaquin River were much greater than at those sampled along the Sacramento River. This is due for the most part to an earlier irrigation season in the San Joaquin Valley, when the fields are being flooded as the peak of the seaward migrant salmon run is passing. One of the larger diversions near Stockton was found to have taken over 20,000 young salmon in late March and April alone.

Butte Creek

Work in 1956 centered on Butte Creek, an important tributary of the Sacramento River. Eight large diversions are present along a 25-mile section of this stream; one was screened experimentally. It is essential that they be evaluated with respect to fish losses before a screening program is developed. However, due to floods during the previous winter, no young salmon

At left department personnel and members of Kamloops, Inc., count and measure marked steelhead at Coleman Hatchery. Yearling steelhead are released (right) after marking into the Sacramento River at Princeton Ferry.
(Fish and Game Photos by Don LaFaunce)

were found either in the diversions or in Butte Creek in the spring of 1956. This work will be continued in 1957.

Considerable losses of adult salmon were observed in diversions from Butte Creek in the spring of 1956, and recommendations for elimination of these losses were made. Some of the answers to fish screening problems have been found, but many problems still remain, and the department is working toward solutions.

Evaluation of Steelhead Planting

Since completion of Shasta Dam, the Sacramento River has become excellent habitat for steelhead trout. Releases from the dam have lowered river temperatures to a level ideal for steelhead. Many fishermen now travel considerable distances each fall to fish the upper Sacramento. Creel censuses indicate that at least 10 percent of the anglers are from Los Angeles County. Questions of whether present regulations are adequate to maintain the excellent fishing, in view of ever-increasing fishing pressure, and whether it is economically feasible to maintain or even improve the fishing by planting yearling hatchery-reared fish, are being studied.

Knights Landing Project

To answer these questions, the department is marking and planting hatchery-reared steelhead in the upper Sacramento River. This work is supplemented by an adult steelhead trapping and tagging program in the lower river near Knights Landing each fall and winter, coupled with an examination of adult steelhead upstream from the trapping site.

These fish are examined at the project's counting station on Mill Creek, at the United States Fish and Wildlife Service's Coleman Fisheries Station traps on Battle Creek, and in anglers' catches from the upper Sacramento River and tributaries.

During the biennium, 9,037 steelhead were trapped and examined for marks and tags at Knights Landing. Of these, 7,633 were tagged before being released. An excellent return of tags by sportsmen has indicated a harvest of about 30 percent of the runs during the past two seasons.

The steelhead planting program is conducted in cooperation with the United States Fish and Wildlife Service and two sportsmen's organizations: California Kamloops, Inc., and Steelhead Unlimited. The steelhead are reared to yearling size at Coleman Station, where eggs are taken from wild fish trapped in Battle Creek.

Planted Fish Supplement Runs

A total of 447,812 marked yearling steelhead was planted during the biennium. The 177,269 fish released in 1955, as well as the 270,543 released in 1956, were all planted in the Sacramento River at Princeton Ferry. The project has planted 663,260 marked yearling steelhead since its inception.

Approximately 3 percent of the entire run of adult steelhead into the upper Sacramento River system in 1953 consisted of hatchery fish, followed by 8 percent in 1954, and 18 percent in 1955.

Facts gathered to date indicate that steelhead runs in the upper Sacramento River are substantial and that planted steelhead are making a sizeable contribution to the fishery.

Project studies have also shown that the new year-round open season on steelhead in the Sacramento River has not increased the total catch appreciably and is not detrimental to the fishery.

SILVER SALMON

The department introduced 43,025 yearling silver salmon into the Sacramento River System in March, 1956.

These silvers, averaging 11 to the pound, were reared at Darrah Springs Hatchery and planted in Mill Creek, Tehama County. Additional plants will be made during the next two years in an effort to establish silver salmon in the Sacramento River.

SCREENS AND LADDERS

The department's fish screen and ladder program, designed to protect runs of salmon and steelhead, resulted in the construction of five fish ladders and 21 fish screens. The extreme floods of December, 1955, also caused a large amount of repair and maintenance work.

There were three permanent crews involved in screen and ladder work during the biennium. These crews were headquartered at screen shops located at Yreka, Red Bluff and Elk Grove.

Among the five fish ladders constructed, two involved major costs and engineering services. Both were financed largely with Wildlife Conservation Board funds.

The new ladder constructed on the Mokelumne River at the Woodbridge Dam, San Joaquin County, was completed in the spring of 1956 at a cost of more than $31,000.

TUNNEL LADDER

A tunnel ladder constructed at Deer Creek Falls, Tehama County, is the first of this type in California. It has several advantages over conventional types in circumventing natural barriers, such as waterfalls. It is considerably less expensive to construct and equally important, does not detract from the natural beauty of an area.

Considerable experimental work was conducted on screens, including a combination air bubble-sound vibration screen, as well as on new drive and cleaning mechanisms. Table 47 in the appendix lists the streams on which screens and ladders were constructed.

The U. S. Bureau of Reclamation completed the Tracy Fish Conservation Facility which employs a new concept in fish screening. It is a gigantic louver-type structure which passes water and diverts the fish into bypasses. The department acted in an advisory capacity on the project. If successful, the new louver should annually save millions of bass and hundreds of thousands of salmon. A similar type was tested in an irrigation diversion from Deer Creek, Tehama County. The results of this test were promising to the extent that this new screen is expected to fill the needs of a number of larger diversions.

Fish Hatchery Assistant Elvis Gunderson shows husky salmon tagged in Trinity River census.

(Fish and Game Photo)

Pink Salmon

A species of salmon new to the California commercial fishery has recently been taken. Pink salmon, usually found in Pacific waters from Washington to Alaska, appeared in same numbers in the ocean off California in 1953. They reappeared in greater numbers in 1955, when nearly 2,000 were landed from Monterey to Crescent City.

There is no minimum size specified for pink salmon in California laws. Reportedly, fishermen released many pinks less than 25 inches lang (minimum size for silver salmon). Those landed in 1955 averaged 7.6 pounds.

Two groups of pink salmon occur off California. One group south of Pt. Arena moves southward taward the Golden Gate as the season progresses, while simultaneously a second group north of Pt. Arena moves northward into Oregon waters. In 1955 eight pink salmon were caught by river gill netters during August and September. Pink salmon were also observed spawning in the Russian River in the fall of 1955.

Pinks live to be two years old. Landings and spawning runs are characteristically large every other year. A run of pinks should reappear in 1957. None were observed in California waters during 1952 and only a few were seen in 1954 and 1956.

BARRIER REMOVAL

The department removed 20 barriers which had blocked 15 coastal streams during the biennium, thus creating or improving accessibility to 81 miles of fishing waters.

Some of these barriers were formed by small log jams and were removed at relatively small cost. No major log jam removal projects were undertaken during the biennium.

Natural barriers created by rock slides or waterfalls were surmounted by complete removal of the barrier, by the construction of a channel around the barrier, or by building a series of small pool-forming dams to decrease the distance between the top of the barrier and the pool immediately below.

INLAND FISHERIES

Conducting a creel census on the Sacramento River near Ball's Ferry, Fisheries Biologist Bill Van Waert measures an angler's catch.
(Fish and Game Photo by John E. Riggs)

Inland Fisheries activities during the biennium were stepped up in nearly every phase of fisheries management. Certain activities needed to cope with the ever increasing water utilization projects received special emphasis, but increased emphasis was also placed on the many programs designed principally to maintain or improve sport fishing in the face of intensified angling pressures.

Special fact-finding investigations, coupled with extensive negotiations between department fisheries personnel and water development agencies, resulted in adequate protection measures for the fisheries threatened by water developments, as well as plans to take advantage of any new fisheries possibilities they present.

Listed on page 46 are some of the major new public fishing waters created during the biennium. The Folsom Reservoir in Sacramento, Placer and El Dorado Counties, Pine Flat Reservoir in Fresno County, and Isabella Reservoir in Kern County are three of the most important new reservoirs.

Good Fisheries Developing

Efforts to create good fishing in these waters have been an added burden, but have been highly successful in most instances. A splendid smallmouth bass fishery is developing rapidly in Pine Flat Reservoir, and it may well attract state-wide attention by the spring of 1957.

An initial planting of more than 1,000,000 warmwater fish in Folsom Reservoir created some excellent fishing in the spring and summer of 1956. It, too, should develop rapidly into one of the best warmwater fishing waters in the State.

The department's inland fisheries investigations, aimed at learning how to improve and regulate important fisheries to best advantage, provided the basis for all changes in regulations.

They also provided the basis for other management activities such as fish stocking and rescue, rough fish control, flow maintenance dams, construction of screens and ladders, and the installation of other

stream and lake improvement devices. They are among the branch's most important activities.

PRODUCTION AND PLANTING

The period covered in this report saw the completion of California's fish hatchery expansion and modernization program undertaken more than five years ago and made possible by funds supplied by the Wildlife Conservation Board.

During the last fiscal year, California waters were stocked with 18,000,000 fingerling salmon and trout, and 7,500,000 catchable trout having a total weight of 1,333,000 pounds. This compares with a total weight of 530,000 pounds planted just five years ago before the new hatchery program was started.

During 1955, the average size of catchable trout stocked was increased from six to eight fish per pound to four to six fish per pound under provisions of a new commission policy.

Fingerlings planted during the biennium represented 65 percent of the total trout and salmon plant by numbers. By weight catchables made up 94.8 percent of the total.

From July 1, 1954, through June 30, 1956, the department planted 43,685,140 trout and salmon with a total weight of 2,573,701 pounds.

THREE NEW HATCHERIES

Moccasin Creek Hatchery was enlarged, and the Los Serranos Warmwater Fisheries Base was constructed. San Joaquin, Cedar Creek and Nimbus Hatcheries were constructed during the biennium.

The new San Joaquin Hatchery is located below Friant Dam on the San Joaquin River and, through an agreement with the Bureau of Reclamation, water for its operation is obtained from Lake Millerton. The hatchery consists of 36 rearing ponds, 12 circular tanks, a hatchery building with 104 troughs, a food preparation room, adequate refrigeration storage, a shop and truck garage, 10 houses for employees, and four ponds for warmwater fish. The warmwater fish ponds are used principally for redistribution of rescued fish and for raising forage minnows.

The new Cedar Creek Experimental Station, Mendocino County, was completed but suffered extensive damage by flood waters in December, 1955. Repair work at this location has been completed and the station, with eight rearing ponds, is being operated at full capacity. This hatchery is rearing yearling steelhead trout for stocking experiments.

Nimbus Hatchery was constructed by the U. S. Bureau of Reclamation as part of the Central Valleys Project to compensate for lost spawning beds and to aid in the maintenance of salmon and steelhead runs in the American River. It is operated by the department under contract with the Federal Government.

Moccasin Creek Hatchery, which was constructed during the last biennium, has been increased in size by the addition of 12 rearing ponds, an addition to the truck garage, and two additional houses for employees. This hatchery is now capable of raising 800,000 catchable trout and 1,500,000 fingerlings for a total weight of 160,000 pounds annually.

Producing trout for summertime recreation is a year-around job. Here, a worker feeds growing trout at the department's Hot Creek Hatchery in Mono County.

(Fish and Game Photo)

Estimated Catches

Leading Inland Sport Fishes in 1954*

	1954	
	Total	Mean catch per angler
Striped bass	1,443,000	9.3
Salmon (Inland)	201,200	4.6
Steelhead	342,000	6.2
Trout	28,616,000	49.5
Catfish	7,993,000	36.5
Black bass	2,315,000	15.1
Panfish†	10,968,000	53.4

* Based on a postal card survey.
† Mostly crappie and sunfish.

OUTMODED PLANTS ABANDONED

With the completion of the hatchery expansion program, three of the older, outmoded hatcheries were abandoned. The abandoned installations are Prairie Creek Hatchery, Humboldt County; Kings River Hatchery, Fresno County; and Madera Hatchery, Madera County. This brought to 10 the total of outmoded hatcheries that have been closed during the modernization period.

All new hatcheries constructed during the past five-year period have been as functional in design as possible, with low future upkeep costs in mind and labor-saving devices stressed wherever possible.

As a result, the average cost of raising and distributing trout dropped from $1.07 a pound in the previous biennium to 89 cents in 1954-55, and 93 cents in 1955-56. This is particularly noteworthy in view of the general increase in material and labor costs which occurred during the biennium.

"ESCAWEIGHER" DEVELOPED

The major improvement in handling catchable trout at hatcheries resulted from the development of the fish "escaweigher" by department personnel. This device consists of a cleated rubber belt conveyor designed like a grain products conveyor. The fish are delivered to the top of the planting tank in a comparatively dry state and the displacement method is then used in determining the number of fish added to the tank. Sight gauges mounted on the tank, indicate the amount of water being displaced.

This method has been found more accurate than previous methods used, and the "escaweigher" reduces the time in loading 2,000 pounds of fish from about 90 minutes to less than 30 minutes.

With larger loads of fish being hauled and greater distances involved in distribution, improvements also have been made to the large fish planting equipment. The newest fish planting trucks, capable of hauling 2,000 pounds, are equipped with electric refrigeration. Elimination of the use of ice increases the over-all load capacity of the truck and eliminates time lost on the road for re-icing.

The transferring of large numbers of catchable sized trout from distant hatcheries to areas without hatcheries has been facilitated by the construction of temporary fish planting bases. Here, the fish are placed in large holding tanks, and are later reloaded into smaller trucks for planting into streams and lakes. The tanks used at these bases were designed by the department's engineering section, and consist of a half-round, aluminized steel flume with end plates, screens, and water intake and outlet facilities.

Two time-consuming jobs—looding and weighing of hatchery produced trout for planting—are combined into one by the "escaweigher," which cuts time taken by previous operations by two-thirds. Inset shows cleated rubber conveyor belt.

(Fish and Game Photos)

FISH PLANTING BASES

The construction of the following fish planting bases was completed during the biennium:

American River Base—On the South Fork American River near Kyburz in El Dorado County, three tanks. Capacity: 45,000 catchable trout.

Greenhorn Base—On Greenhorn Creek near Quincy in Plumas County, seven tanks. Capacity: 45,000 catchables and 50,000 fingerlings.

Bear River Base—On Bear River near Emigrant Gap in Placer County, two tanks. Capacity: 39,000 catchables.

Fiddle Creek Base—On Fiddle Creek near Downieville in Sierra County, one tank. Capacity: 15,000 catchables.

San Lorenzo Base—On tributary to San Lorenzo River in Santa Cruz County, one tank. Capacity: 15,000 catchables.

DRY FEED EXPERIMENT

The department experimented with dry feeds for trout at hatcheries in place of the conventional "wet" diets, such as frozen liver and ocean fish. While much remains to be done to develop a complete trout and salmon diet, experiments carried on so far indicate that dry feeds may be fed satisfactorily at many hatcheries and produce good fish with less handling of foods.

A complete summation of fish production and distribution will be found in Tables 16 and 18, Appendix.

SALVAGE AND TRANSPLANTING

Work performed in this program included the capture and transplanting of various species of game fish from areas of abundance to areas of need, as well as the rescue of game fish from lakes and streams that became uninhabitable due to lack of water.

Central Valleys Hatchery near Elk Grove continued its role as the center for warmwater fish salvage and transplanting for the State.

Barrels of unwanted carp, a portion of 109 tons removed from City of San Diego's Lake Hodges by chemical treatment prior to restocking with game fishes.

(Fish and Game Photo)

Near the close of the biennium a fisheries field operating station, including warmwater fish holding ponds, was completed at the Los Serranos Game Farm, Chino, by use of funds provided by the Wildlife Conservation Board. This will facilitate the warmwater fish salvage and distribution program and permit greater emphasis to be placed on this important function in the southern part of the State.

Fish Rescue Work

Salmon and trout (principally steelhead) rescue work is done primarily in the coastal stream basins from San Luis Obispo County to the Oregon border. Several temporary fish rescue crews operated from strategic locations during the biennium. These crews saved large numbers of salmon and steelhead from drying streams.

The rescued fish were released in waters having a permanent flow, preferably in the same drainage system, where they could continue their natural life cycle.

Total fish salvaged and transplanted during the period from July 1, 1954, through June 30, 1956, amounted to 2,122,468 warmwater fish, 194,915 salmon, 1,339,756 trout (principally steelhead) and 7,150 miscellaneous saltwater fishes.

A tabulation of fish salvaged by individual species is found in Table 7, Appendix.

STREAM AND LAKE IMPROVEMENT

The biennium saw a great deal of progress in stream and lake restoration and improvement of environment. Activities of this nature were increased in nearly all areas of the State. Certain types of habitat improvement work took place in all of the regions, while other types of improvements were confined to only one or two regions.

Fish screens and ladders were emphasized where there are migrations of salmon and steelhead, while pool building devices were emphasized on Southern California trout streams where there is a shortage of natural pool areas for carrying trout.

FIVE STANDARD METHODS

The most common methods used to improve lakes and streams so as to increase the production and utilization of game fish are:

1. The elimination or control of unbalanced populations of fish through chemical treatment or other methods designed to achieve a material reduction in numbers of nonsport fish.

2. The construction and maintenance of fishways over barriers or the removal of barriers, both natural and man-made, so that adult migratory fish may reach additional spawning areas.

3. The construction of stream flow maintenance dams which improve stream flows to aid natural trout propagation and survival.

4. The construction of fish screens or barriers to confine fish to safe waters, or to public waters, or to waters where they may be utilized by the public.

5. The construction of stream deflectors, pool-creating devices, and other structures which increase the fish-carrying capacity and angler harvest from fishing waters.

Fish Population Control

The chemical treatment of waters to remove undesirable fish and to rehabilitate the sport fisheries was nearly three times as great during the past two years as in any previous biennium. This increase may be attributed to the success of past work of this type, as well as a great improvement in the chemical compounds and methods of application.

Stunted adult crappie from Hansen Park Reservoir, Los Angeles County, were removed by chemical treatment prior to restocking with bass and forage minnows.

(Fish and Game Photo)

Treating the Russian River to remove unwanted rough fish.
(Fish and Game Photo)

A new type of lightweight paddle wheel chemical mixer was developed and was instrumental in the distribution of powdered chemical from boats. The two chief manufacturers of fish toxicants have succeeded in developing highly effective emulsions. These emulsions are somewhat more expensive than the powdered form, but the savings in equipment and labor used in their application compensates for the additional cost.

Aircraft Used

The use of aircraft to spread the chemicals in remote mountain lakes was tested and found quite promising. Once developed, this should greatly reduce costs for treatment of certain lakes.

A total of 58 lakes was chemically treated during the period from July 1, 1954, through June 30, 1956. This treatment will create improved fishing in approximately 11,450 surface acres of water. In several instances advantage was taken of seasonal drawdowns of reservoirs. Scheduling the treatment when the reservoir pool is at a minimum reduces the cost of the job many fold and assures a more successful control.

An outstanding example of this type of operation took place on the Dallas-Warner Reservoir in Stanislaus County. This 3,800-acre lake was chemically treated when drawn down to 280 surface acres.

Air Boat Used

An air boat (a shallow draft boat powered by an airplane propeller) was used successfully to spread the rotenone over the many shallow areas which otherwise would have been difficult to treat. The lake was restocked with suitable varieties of warmwater fish, and they have produced good fishing.

San Diego Story

For the first time in California a municipal water supply impoundment was chemically treated to remove rough fish. The date was January 31, 1956. The place was Hodges Reservoir of the City of San Diego. Fish toxicant was used to treat this body of water and the fish kill was believed complete. More than 100 tons of carp were removed.

State and local health departments followed the operation with considerable interest; no similar project, involving a large supply of domestic water, had ever been attempted heretofore in California.

The project succeeded in improving both water quality and conditions for a sport fishery. San Diego is one of the few cities that permit fishing in its domestic water supply; consequently, the success of the fish-killing program is of far reaching importance to anglers all over the State.

Many Streams Treated

In addition to the lakes, 25 streams with a total length of approximately 245 miles were treated. Several streams in the Russian River drainage were treated, completing a job (286 miles) started in the 1952-54 Biennium. It was the largest chemical treatment program ever undertaken on a river system. The stream was treated to reduce the population of squawfish, suckers, roach and carp and improve conditions for natural reproduction of steelhead.

At the end of the biennium, the rough fish appeared to be making a comeback, but were still not up to their former numbers.

Meanwhile summer trout fishing had greatly improved. Effects on the winter steelhead fishing will not be felt until the large crops of fish spawned after treatment reach maturity and come back into the river from the ocean.

Putah Creek Project

A second major rough fish control project involving a stream drainage was conducted in Putah Creek, in Napa and Lake Counties. There 45 miles of stream was treated in an effort to control carp in the drainage area above the Berryessa Reservoir to be created by Monticello Dam.

Table 23, Appendix, contains a tabulation of the waters which received complete chemical treatment, and also lists the fish species restocked.

It does not, however, list the waters which received partial chemical treatment to reduce heavy concentrations of undesirable fishes in shallow inlets or shoreline areas.

Partial controls of this type were undertaken at Cachuma Reservoir, Santa Barbara County, and at El Capitan Reservoir, San Diego County.

Flow Maintenance Dams

The construction of new stream flow maintenance dams was stepped up somewhat during the biennium. The Wildlife Conservation Board provided funds to finance the major portion of this work.

Nearly all of the new dams were constructed in two of the State's most popular trout angling counties, El Dorado and Tuolumne, where 20 were constructed or enlarged during the two-year period. Table 47, Appendix, lists the streams benefited by this work.

In addition to the actual dam construction, considerable effort was expended in removing dead trees and debris from the impoundment areas of other stream flow maintenance dams constructed in the previous biennium.

The operation of a large number of these dams and recording of water flows relating to the operation was turned over to Wildlife Protection personnel, and the wardens who were assigned this added responsibility have done an excellent job. Generally, the dams are receiving far better and more frequent attention than they had received.

The problem of measuring water flows below many dams in El Dorado County was largely alleviated by the Mount Ralston Fish Planting Club of Sacramento. This club constructed flow measuring weirs below 12 existing dams, thus making it possible to measure, record, and change water flows quickly and easily.

Hume Lake Dam.
(Fish and Game Photo)

Lake Improvement

Flow maintenance dams frequently benefit a lake through enlarging it as well as benefiting the stream below. However, a number of projects were planned specifically to create or improve lakes. Some of these projects are listed below.

In order to stabilize the water level of Chiquito Lake, Madera County, a rock-masonry main dam and saddle dam were constructed. The main dam is 27 feet long and raises the lake about two feet. A 43-foot saddle dam was also necessary to contain the lake. This work has resulted in an increase in surface area from seven acres to a constant high of 20 acres.

A small dam was constructed on Little Kern Creek with a cement-lined diversion ditch to Little Kern Lake. The purpose of this project was to supply Little Kern Lake with a constant flow of fresh water, thereby creating improved fish habitat.

Experimental work was carried on to open public access through dense cattails and tule growth around Lost Lake, Fresno County, and ponds on the Los Banos Waterfowl Management Area, Merced County. Explosives were used to blow out masses of vegetation. Experiments were also conducted with the use of chemicals to remove the emergent plants. Although results were inconclusive at the end of the biennium, it now appears that cattails and tule growth may be effectively controlled without harm to fish life or surrounding agricultural land.

Hume Lake Dam Repair

The dam creating Hume Lake, Fresno County, was repaired with Wildlife Conservation Board funds at a cost of $64,905. Before refilling, the pools and tributary streams were treated with chemical to remove warm-water fish. Rainbow trout were stocked and have provided excellent fishing.

Serious leakage of the dam creating McClure Lake in Madera County was repaired. Forty percent of the dam face was sealed with watertight compounds after removing loose rock and mortar. Additional repairs were made to the footing of the dam by the Forest Service.

Lake level maintenance dams were constructed at the outlets of Maria, Upper West and Lower West Lakes, Nevada County, to increase their depth and prevent seepage losses. In cooperation with the Truckee Outdoor Sportsmen's Club, sloping screens were installed at the outlets to prevent downstream migrations of fish from the lake. Many fish formerly perished each year when the outlet stream went dry.

Winter Carryover Experiment

Dry Lake, San Bernardino County, at 9,100 feet altitude, averages about five feet deep. Due to heavy winter ice formation, the carryover of trout in this lake is virtually nonexistent.

In attempting to improve the winter carryover of trout by increasing the depth, one case of 40 percent gelatin dynamite was detonated in five different locations. Holes ranging from four feet square and four feet deep to holes 15 feet by 35 feet by 6 feet deep were created. Future checks will determine whether this work is effective.

In addition to the experimental control of cattails and tules through the use of chemicals, a number of tests were made with other chemicals to control submerged aquatic weeds. This control of submergents has proved more difficult than the control of emergent plants. This is because the concentrations of certain chemicals necessary to eliminate weed growth are frequently lethal to fish or desirable terrestrial plants.

Miscellaneous Improvements

The Southern California stream improvement program, made possible by Wildlife Conservation Board allocations, continued through the biennium.

A new type rock-masonry, flow-accelerating structure was devised, which is a considerable improvement over the log and rock dams and deflectors tried in 1953-54. The chief function of these structures is to create additional pool areas in streams requiring them. A total of 196 devices of this type was constructed on Southern California streams.

Pool-forming devices were constructed with logs in a one-third mile section in the headwaters of the South Fork of the Mokelumne River, Calaveras County, in 1955. Prior to construction, the fish population was carefully censused with an electric fish shocker. All fish were counted, weighed, and fin clipped for future recognition. The plan is to recensus the stream in future years to determine the influence of these devices on the fish population.

Experimental Structure

An experimental structure consisting of two parallel rows of sheet piling anchored to piles was constructed at the outlet of Taylor Creek into Lake Tahoe, El Dorado County, in the summer of 1955. The purpose of the structure was to maintain an open channel for fish migration through the sand bar that forms at the mouth. The structure was a cooperative venture with the County of El Dorado which contributed $660 towards the total cost of $3,660. The structure functioned perfectly in the fall of 1955 and fish had no difficulty entering Taylor Creek, but the December, 1955, floods washed out the upper end of the structure. Efforts were being made at the end of the biennium to obtain funds for reconstruction.

INVESTIGATIONS

The need for more information about the State's inland fisheries has become increasingly apparent as more and more water use projects are planned and angling pressures continue to mount.

As in the past biennium, the investigational work generally fell into two groups. Surveys or inventories of local importance, including many water projects studies, were conducted by regional fisheries workers. Basic or long-range research projects were conducted by staff personnel. Close cooperation and frequent contacts between staff and regional fisheries workers made the work of each group more successful.

Stream and Lake Surveys

Initial biological surveys were made of 244 lakes and 107 streams. (See Table 11, Appendix.) Rechecks were made of many other waters to determine the success of existing management programs and regulations.

All of the stream and lake improvement activities listed in this report came about as results of stream and lake surveys.

Creel Censuses

Creel census work was increased considerably. Table 12, Appendix, lists the 145 streams and lakes on which important information regarding angler use and success were collected. In addition to these, spot censuses were made of many individual waters.

This work is one of the most important activities carried on by the department. It provides the basis for fish planting allotments, the evaluation of regulations, determining the economic importance of the fishery in relation to other water uses, and it provides close contact between the angling public and fisheries workers.

A few of the waters listed in Table 12 such as Castle Lake in Siskiyou County, Rush Creek in Mono County, and the Lakes Basin area of Plumas and Sierra Counties were special test waters where the results of study can be applied to similar waters.

FISH DISEASE STUDIES

As fish production has increased, so have the demands for fish disease services. During the biennium, virtually all of the effort carried on in fish disease work has been restricted to providing services at state hatcheries.

During the 1950-52 period the department's disease control program investigated 116 cases of diseased fish. Of this number, 51 involved fish at state installations. The remainder of the work involved commercial hatcheries (24 cases) and wild fish (41).

In 1952-54, the effects of the increased hatchery program began to be felt and fewer fish disease services were available for commercial and wild fish investigations. With the completion of the hatchery expansion and modernization program in the recent biennium, the pattern of fish disease services shifted almost entirely to hatchery investigations. Of 120 cases studied, 112 involved fish at hatcheries.

Gill Flukes

Special studies were made of two important trout diseases. The first disease was caused by a gill fluke which is particularly serious at the Darrah Springs Hatchery, and is also important at the Mt. Shasta and Crystal Lake Hatcheries. At the present time it appears that snails of the genus *Goniobasis* act as the intermediate hosts for the fluke.

Some strains of rainbow trout are highly susceptible to this disease and die in considerable numbers; other strains are relatively immune. However, when the gills become heavily parasitized the health of the fish is impaired even though it may not die. An attempt will be made to break the life cycle of this gill worm at the Darrah Springs Hatchery by a partial eradication

Department disease labaratary men (Harald Wolf, left, and Bill Schafer) investigate a traut disease threat in a commercial hatchery that supplies fish to private waters cannected with public fishing waters.

(Fish and Game Photo)

of the snails and the wild fish in the hatchery water supply.

The second trout disease to receive special attention during the biennium was redmouth, a bacterial disease of the blood and various tissues of rainbow and eastern brook trout.

It was found that some commercial trout hatcheries in other states were seriously affected by this disease.

It was shown in a survey that about 1,000,000 live trout a year were entering the State and that the number would increase.

Inspection of Shipments

After this was established, an investigation showed that there was a danger of introducing diseased fish into state waters. It was then decided that each shipment of live trout would be inspected for redmouth as well as other diseases, and only if found to be free of disease could they be delivered into California. At the same time all the commercial trout hatcheries and all the state-owned hatcheries in California were inspected for redmouth. The disease was found in seven commercial hatcheries and one state hatchery.

Treatment of the infected fish with sulfa drugs was recommended and these lots of fish were quarantined until inspection showed that they were free of the disease. It is believed that redmouth will not cause the State serious trouble as long as infected trout are prevented from entering California, and as long as routine inspection of all trout hatcheries, both commercial and state-owned, is continued.

WARMWATER FISH STUDIES

The emphasis of the state-wide warmwater research program remained on the problem of providing forage for largemouth bass.

Five species of small fish thought to have potential value as forage have been planted throughout the State. The fathead minnow and golden shiner have become established in several lakes and reservoirs but have not provided the forage expected of them. The plains red shiner has been extremely successful in the Colorado River area, but its value is not clear elsewhere. Although the native freshwater smelt found in the lower reaches of the Sacramento and San Joaquin Rivers has been introduced into three colder foothill reservoirs, no evidence of reproduction has been found.

THREADFIN SHAD

The threadfin shad, imported from the Tennessee River in 1953, has been very successful and shows great promise as a forage species.

It was introduced into San Vicente Reservoir, San Diego County, in June, 1954, and has successfully reproduced. It is now found throughout the reservoir and is being utilized by the sport fish. Its effect on the fishery in terms of increased angling success has not had time to become apparent. The fluctuation of the

reservoir has not affected its spawning, and it is utilizing the open waters not previously used by the other fish.

Two introductions of this fish were made into Lake Havasu on the Colorado River, one in December, 1954, and another in March, 1955. By July, 1955, shad were found throughout the river from below Davis Dam to Yuma, Arizona, and in the Salton Sea. In April, 1956, an extensive evaluation program was begun. The results to date show that the shad is being utilized by the largemouth bass as forage. There is some indication of an increased growth rate for the bass that started in the spring of 1955 when the shad were populating the river at a rapid rate. The relationship of the shad to the channel catfish is not clear. The evaluation program is only in its initial phase, however.

Increased angler success at Lake Havasu has been attributed to the shad.

Puddingstone Reservoir, Los Angeles County, was stocked with shad in March, 1955. They have done very well here and appear to have favorably influenced the fishery. The survival of largemouth bass has been increased.

POPULATION STUDIES

In warmwater impoundments the fishery is supported by a number of different kinds of fish rather than just one or two as in trout waters. This complicates management practices as control or heavy use of one fish often markedly affects the numbers or success of other fish. Because of the close relationship between forage fish, sport fish and rough fish, such as carp, a knowledge of population size and composition is essential for intelligent management. It may be possible, for instance, to improve the fishing in a water by the control or introduction of different fish. An example of such a manipulation is the introduction of the threadfin shad into the Colorado River.

This population information is gathered in a number of ways, some of which are by no means simple. A short-term, intensive survey method has been developed and applied in waters throughout the State from Modoc County to San Diego County.

Included in these surveys were: Big Sage Reservoir, Modoc County; Lower Susan River, Lassen County; Millerton Lake in Fresno and Madera Counties; Pardee Reservoir in Amador and Calaveras Counties; Turlock Reservoir, Stanislaus County; several San Diego County reservoirs and Salt Springs Valley Reservoir, Calaveras County. Much of the information gathered in these studies is now being applied in the management of the waters.

PRE-IMPOUNDMENT SURVEYS

Two pre-impoundment surveys were made. The American River above the Folsom Dam site was sampled in 1955 and again in 1956, as was Putah Creek above the Monticello Dam site. The information obtained will be used in the management program for the completed reservoirs. Evaluation of rough fish removal prior to the flooding of new reservoir basins is also in progress.

In 1953 a largemouth bass tagging study was begun at Clear Lake, Lake County. The purpose of the study was to determine the harvest rate for this species.

Boat launching beach at Folsom Lake, one of the State's newest warmwater lakes.

(Fish and Game Photo)

Three-year tag returns were received permitting the calculation of basic mortality figures never before available for largemouth bass. These were possible only because a better tag was developed. Similar data was obtained at Sutherland Reservoir, San Diego County.

Fish diseases and parasites, normally serious only in crowded hatcheries, have not been thought to be a problem in wild warmwater fish populations. In several waters where the largemouth bass spawning success was very high, serious infestations of heart nematodes were discovered. These may be one of the causes for the great fluctuations in year classes that commonly occur in these waters. The effect of the parasite is not fully known and a control method has yet to be devised.

NEW FISH

In addition to the importation of new forage fish, several new sport fish were brought into the State. One of these, the redeye bass, brought in during the previous biennium, was unsuccessful and none are now found in the State. The redear sunfish was imported in 1954 and propagated in Southern California and at Central Valleys Hatchery. It has been planted into ponds and lakes and is now being observed. The range of the pumpkinseed sunfish in California was extended by a series of experimental plants in the colder ponds of the central coastal region.

White crappie, and the native Sacramento perch were both tried in new waters. Only the white crappie has offered improved angling.

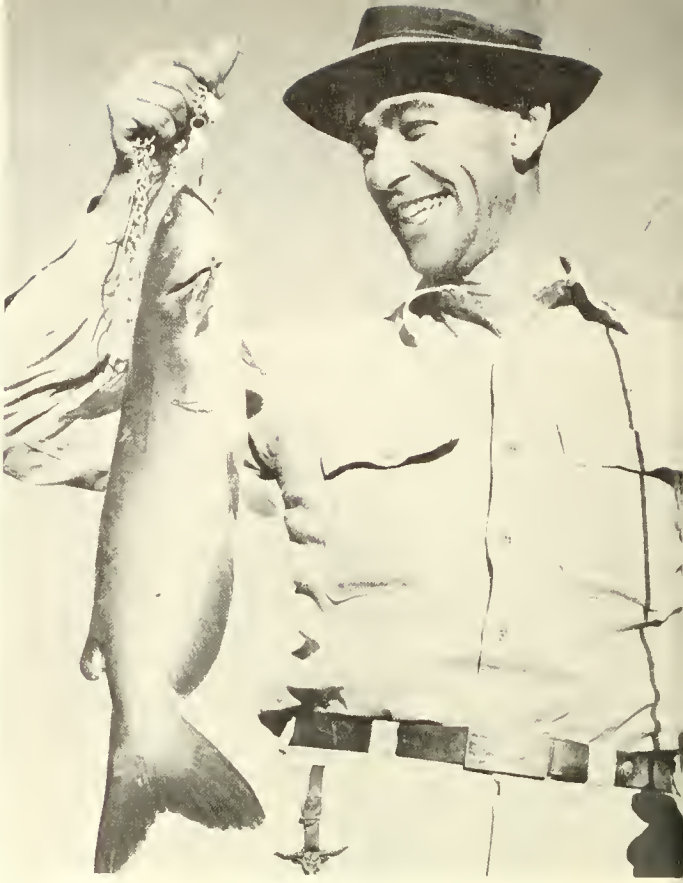
The success of the landlocked striped bass in the east, together with a need for a control on a stunted panfish population resulted in an introduction of this species into Millerton Lake in 1956.

CATFISH STUDY

Since World War II, the once lowly catfish has risen rapidly in the esteem of California's anglers. An indication of its popularity as a game fish is revealed by the fact that approximately 19 percent of California's license holders fished for them in 1955. The total catch that year was 7,500,000 catfish, making California the leading state in the Nation in sport fishing for catfish.

Increasing fishing pressure on the State's catfish populations created an urgent demand for statistical data on the major fisheries, and data on the life histories of the most important catfish species. Information of this type was necessary in order to establish a factual basis for the proper management of the fisheries.

An opportunity to obtain valuable information about little known catfish was presented in 1951 with the availability of federal aid funds for sport fish investigations.



Angler Phil Douglas displays big channel catfish he took from the Colorado River.

(Fish and Game Photo)

A Federal Aid Project was started in 1952, and was the first freshwater investigation in California supported with funds derived from excise taxes on fishing equipment. Having accomplished its original objectives, it was terminated on June 30, 1956.

Tagging Studies

Considerable effort during the biennium was directed toward completion of tagging investigations already in progress in the Sacramento-San Joaquin Delta, Clear Lake, and the Colorado River.

The Delta tagging experiments on white catfish have been remarkably successful. Anglers have returned over 1,300 tags from the 6,966 tagged fish released since the inception of the project. The results of these studies have made it possible to calculate the vital statistics of the Delta catfish population with a degree of accuracy seldom, if ever, realized before in any similar studies conducted anywhere in the world. Valid measures of annual survival, rate of exploitation, rate of natural deaths, and annual total mortality have been obtained. Such data will be invaluable in the conservation of the Delta catfish resource.

The principal factors responsible for the success of these experiments have been the development of a tag that will remain on the catfish for three years or more and the noteworthy cooperation of sportsmen who voluntarily reported the capture of tagged fish.

Certain sportsmen's groups, such as the Foothill Sportsmen's Club of Oakland and the Twin Cities Rod and Gun Club of Yuba City have contributed greatly by sponsoring prize drawings for anglers who reported capture of tagged catfish.

Channel Catfish

A tagging study on channel catfish in the Colorado River, which was begun in 1954, was completed during the biennium. Results of the study indicated that the fishery is being exploited at a safe level and no drastic changes in regulations are necessary.

Tagging studies at Clear Lake, in which 3,500 white catfish and brown bullheads were tagged in 1952 and 1954, have demonstrated clearly that the fishery is greatly underexploited. The annual harvest is only about 2.5 percent of the catchable population. In other words, most Clear Lake catfish simply die of old age. An increased bag limit and liberalization of certain gear restrictions have been recommended to encourage better utilization of this resource.

The important channel catfish fishery in the Lower Sacramento River system and Sutter Bypass was the subject of a tagging study during 1955 and 1956. Tag returns after one year indicated that the annual rate of harvest is approximately 20 percent of the catchable population.

While fishing for striped bass in the Sacramento River off Port Chicago, Catolino Diongsan of San Francisco hooked into this 277-pound sturgeon. Victory over this 8-foot, 5-inch giant required 1 hour and 20 minutes.
(San Francisco News Photo)

Sampling to determine abundance of young striped bass in the Sacramento-San Joaquin delta area.
(Fish and Game Photo)

Life History Studies

Successful management of a fishery must be based on a thorough understanding of the biology of the species concerned. Consequently, a major portion of the catfish study program was directed toward gaining an understanding of catfish life histories.

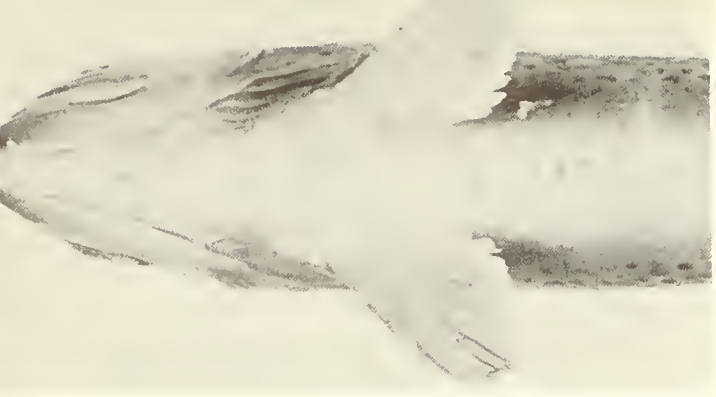
Emphasis was placed on study of the biology of the white catfish in the Delta, since the Delta fishery is the largest and most important in the State. By the end of the biennium, data on age and growth, food habits, size at maturity, reproductive characteristics and diseases had been obtained.

The age and growth and food habits of channel catfish in the Colorado River was studied in order to evaluate the effects of the experimental introduction of the threadfin shad into that important river. The catfish project started this work and it is being continued under the warmwater research program.

Valuable facts about the food habits and age and growth of catfish in Clear Lake have also been obtained during the course of project activities.

STRIPED BASS AND STURGEON

The 1954-56 biennium coincides with the first two years this federal aid project has been in operation. The striped bass fishery is an extremely valuable one,



Trout tagged on under side.
(Fish and Game Photo by E. P. "Phil" Pister)

providing an estimated 2,000,000 days angling and 1,500,000 fish to 150,000 anglers annually.

During the biennium the system of postal card and party boat catch reports has been maintained and improved. An evaluation of the status of the fishery based upon these records and data obtained through special striped bass angler interviews and surveys was made. It was shown quite conclusively that there has been a gradual but decided decline in the total catch and average angler success. Individual angler success is now only about one-half what it was during the pre-war years.

Bass Size Limit

In an attempt to improve the present quality of angling a 16-inch minimum size limit and three fish bag limit was recommended. These recommendations were based on the biology of the striped bass and angler catch records.

The annual striped bass fry surveys, which indicate spawning success and the distribution and abundance of fry on the nursery grounds, was continued. Spawning success in 1955 and 1956 appeared to be very poor in comparison with 1953 and 1954. The distribution of fry and fingerling bass is an important consideration in relation to the large water diversions in the Delta and in industrial pollution.

Commercial Gill Netters

During the biennium, project personnel investigated the commercial salmon and shad gill netters in the Delta to obtain estimates of the number of game fish destroyed during normal commercial operations. The study was conducted during the 1954 and 1956 shad seasons and the 1955 salmon season.

The investigations have shown that a greater number of bass are caught in the channel areas than in the shallow flats of Honker and Grizzly Bays. However, in the flats the percentage of striped bass in the catch is almost twice that of the channels and the percentage of mortality is also much greater. It is apparent that the flats gill netters inflict the greatest relative amount of damage in terms of fish destroyed per number or poundage of marketable fish.

Salmon catch figures have been computed for the last 10 years. Since the loss of the San Joaquin spring salmon run, the August 10th to September 26th commercial season provides about 97 percent of the total annual river salmon catch. Gill netting for the few salmon caught throughout the rest of the year does not seem to justify the losses of bass caught in gill nets.

On the basis of the data brought out by these investigations the department is recommending additional measures to protect the sport fishes.

In 1954 the taking of sturgeon on sporting tackle was legalized for the first time in 37 years. The department felt that they were once again abundant enough to support a hook and line fishery.

Sturgeon Size Limit

A sturgeon investigation was initiated to provide the necessary data for the proper management of these fish. A total of 1,003 white sturgeon were tagged in San Pablo Bay. Tag returns indicate they are not being overharvested by the anglers, although a considerable number are caught by commercial gill netters. The pattern of migrations has not yet been worked out in detail but there appears to be a general tendency for them to move upstream in the late fall and winter. Two returns of San Pablo Bay were recorded from near the Columbia River in Oregon.

A method of determining the age of sturgeon was developed and an age and growth formula has been computed. This study showed that the San Pablo Bay population was principally composed of 6- and 16-year-old fish. The fishery is apparently dependent upon a few successful year classes. It was shown that a size limit of 50 inches offers greater protection for the fishery than 40 inches. Sturgeon do not mature until they are 15 to 20 years old and should be given protection at least to that size.

Pollution Investigation

Project personnel ran a series of bioassays on the waste effluent from an industrial plant near Antioch and found it to be quite toxic to fish life. Another series of tests is being run on the effluent, using striped bass as the test fish. As a result of these tests improved standards were required by the Pollution Control Board and plant waste discharges are noticeably better.

TROUT MANAGEMENT STUDY

Nearly all of the department's basic trout research is now performed under the auspices of a single Dingell-Johnson (Federal Aid) project, which was enlarged during the biennium to include work on catchable trout evaluation.

During the period, project activities were devoted primarily to: (1) basic trout disease studies; (2) developing methods for the evaluation and improvement of trout planting; (3) comparing different species and strains of trout to determine which are the most suitable for the various types of California trout waters.

Board designed by department to encourage tag returns.
(Fish and Game Photo)

Since the hatchery and planting program takes up the largest portion of the department's fisheries budget, a major effort was put forth in exploring and developing methods to assure that the public will receive maximum value from the planted fish.

NEW TAG DEVELOPED

A special tag was developed from vinyl plastic. It is placed under the thin skin covering the ventral surface of the trout, but does not affect growth or behavior of the fish. It has enabled the research workers to follow particular groups of planted fish and to determine, through the return of these tags, many things. These include total catch of the planted fish, migration from the area of plant, growth of the trout, and overwinter survival—in essence, the value of the planted trout to the angler.

Special tagging studies were carried out on various types of waters receiving large plants of catchables.

Some of the waters on which the department made test evaluations are: South Fork of the American River, El Dorado County; South Fork of the Yuba River; Lake Pillsbury, Lake County; Big Bear Lake, San Bernardino County, and the Kern River in Kern County.

Tag Returns Encouraged

A great deal of publicity was given to the studies at the latter two waters in order to encourage tag returns. An added incentive for tag return was the donation of money and awards by sportsmen and local businessmen at public drawings.

Other waters of the State will be studied to determine whether they fall within the observations made to date. Ultimately, through the methods used here, fisheries managers in the regions will be able to determine more effectively the value of catchable trout in their particular areas. Adjustments will be made from water to water to utilize more effectively the hatchery product. Total planting of catchables on some waters will be increased and others decreased to the general good of the fishing public.

The comparison of different species and strains of trout in various types of California waters mainly involved the planting of different lots of marked hatchery fish and the checking back of returns to the angler through intensive creel census studies. Other work performed in conjunction with this phase of the project consisted of comparing survival of trout planted by air with others planted by truck or packstock. These studies were conducted at Castle Lake in Siskiyou County, Rush Creek in Mono County, and at several lakes in the Lakes Basin Recreation Area of Sierra and Plumas Counties.

Castle Lake Study

The results of the eastern brook trout phase of the Castle Lake study were published in April, 1956, issue of *California Fish and Game*. Some of the more important points brought out by this study are the following:

1. After the removal of the predatory brown and lake trout in 1946, the survival to the angler of eastern brook fingerlings jumped from 1.9 percent to 35 percent of those planted.

2. Although 1,503 pounds of yearling brook trout were planted in 1947, only 978 pounds of fish from this plant were eventually caught by the anglers. In marked contrast, 100 pounds of brook fingerlings planted in 1948 yielded 923 pounds to the anglers.

3. If predatory fish are not present, brook trout fingerlings when planted will yield a high return to the angler, and many will remain in the lake to spawn and establish a large self-propagating population.

4. In Castle Lake at least, the brook trout is rarely cannibalistic, so if too many are planted or if too many are propagated naturally the food supply of the lake will not be sufficient, and thin, stunted trout will result.

5. The average catch of brook trout by the anglers was about 10 pounds per acre per year.

Two Important Studies

Some of the facts gathered in the Lakes Basin Recreation Area and at Rush Creek which could

Major New Public Fishing Waters

NEW WATERS COMPLETED BETWEEN JULY 1, 1954, AND JUNE 30, 1956

Name of water	County	Surface area in acrea	Construction agency
REGION I			
None noted			
REGION II			
Folsom Reservoir	Sacramento, Placer, El Dorado	11,500	U. S. Corps of Engineers
Nimbua Reservoir (Lake Natoma)	Sacramento	560	U. S. Bureau of Reclamation
Sly Park Reservoir	El Dorado	650	U. S. Bureau of Reclamation
REGION III			
Kent Lake	Marin	265	Marin Municipal Water District
Chesbro Reservoir	Santa Clara	300	South Santa Clara Water Conservation District
REGION IV			
Avocado Lake	Fresno	83	U. S. Corpa of Engineers
Pine Flat Reservoir	Fresno	6,300	U. S. Corps of Engineers
Isabella Reservoir	Kern	5,200	U. S. Corps of Engineers
Los Banos Ponds	Merced	200	Wildlife Conservation Board
Hume Lake*	Fresno	75	Wildlife Conservation Board
Vermillion Reservoir	Fresno	1,890	Southern California Edison Co.
REGION V			
Santa Felicia Reservoir	Ventura	1,235	United Water Conservation Diatrict of Ventura County

* Repair and rehabilitation.

have considerable influence on the department's trout management program are:

1. The "Splake," a hybrid fish resulting from the cross of eastern brook trout and lake trout, was found to do extremely well in Lower Salmon Lake, Sierra County. Several thousand of these fish were planted in the late summer of 1955 at an average size of 12 fish per ounce (under two inches in length). The following spring they entered the catch in good numbers and had attained an average length of more than 6½ inches.

2. Strains of brown trout developed in the eastern states through many years of selective breeding were brought into California and appear to be showing a better return to the angler than California brown trout planted in the same waters. Tests indicating this were conducted at Rush Creek and at Lower Sardine Lake, Sierra County.

3. Rainbow trout imported from British Columbia, when compared with rainbow trout from California's hatcheries, have shown considerable less return to the angler. This is offset somewhat by the Canadian rainbow's greater sporting qualities, preference for artificial flies over bait, and the fact that returns from a plant of these fish of catchable size extend over a longer period.

WILDLIFE CONSERVATION BOARD

(Continued from page 20)

Fish Screens and Ladders

Fish screens were authorized for several irrigation diversions where fish losses were the most acute. An allocation was made for a fish ladder at the Lower Durham-Mutual Water Company diversion in Butte County. Funds were allocated for plans and specifications on several other proposed ladders. The Battle Creek screen was completed, as was the Deer Creek Falls fish ladder. Funds were withdrawn from the previously authorized Glenn-Colusa Canal screen when engineering estimates proved the project to be too costly.

Hatcheries and Stocking

Modernization of the fish food storage facilities at the Fillmore Hatchery in Los Angeles County was completed. The proposed San Gabriel Hatchery in Los Angeles County was withdrawn because of questionable water supply.

Funds for broodstock ponds at the rehabilitated Mt. Shasta Hatchery in Siskiyou County and a 150-tray bank incubator for the Mt. Whitney Hatchery in Inyo County were allocated. Funds were approved for studying the feasibility of expanding several hatcheries in Region V in Southern California.

In addition, funds were allocated for projects previously approved. They were the Cedar Creek Hatchery, fish planting tankers, Darrah Springs Hatchery, Moccasin Creek Hatchery, Mojave Hatchery and Hot Creek Hatchery.

WATERFOWL

The waterfowl management area program was almost completed. Some construction work remained to be done on Lower Butte Creek Waterfowl Management Area in Butte County, the Mendota in Fresno County, and the Delta (Grizzly Island) in Solano County, and additional allocations were made for this purpose.

Practically all land acquisition has been completed.

One small project, Sheepy Ridge Waterfowl Public Shooting Area, in Siskiyou County was approved and acquired.

MARINE FISHERIES

Beach seining to capture surf fish for tagging.

(Fish and Game Photo by Charles F. Crawford)

The long continuous shoreline of California, stretching more than 1,200 miles from Oregon on the north to the Mexican international boundary on the south, is playing a major part in the development of agriculture, industry and the recreational life of the inhabitants of this State.

From the sea comes basic wealth—protein and nourishment for the inhabitants of the State and the Country. From contact with the Pacific comes the health-giving opportunity for marine recreation and fishing.

The commercial fishing industry is one of the major segments of the economic life of our State. The State of California alone supplies over 90 percent of the canned tuna of the Nation. Sportfishing in the ocean is an additional important factor in the economic welfare of the citizens of this State.

California has one of its biggest stakes in its ocean fisheries, both commercial and sport. The orderly development and utilization of these fisheries for the major enjoyment and benefit of all is the responsibility of the Marine Fisheries Branch.

Marine Fisheries Commission

The Pacific Marine Fisheries Commission was formed in 1947. It is the result of a compact between the States of California, Oregon, and Washington, and was created to promote the better use of those fisheries which are of mutual concern to the three states and to recommend parallel conservation legislation.

General meetings are held once a year usually in November or December. The meeting place is rotated among the three states. Attendance includes the commission, advisers from the fishing industry, research staff members from the three states and the general public.

Canada, Alaska, and the U. S. Fish and Wildlife Service send representatives to the general meetings and to the research staff meetings, which are also held once a year. Wherever possible the study and management programs of these groups are coordinated with those of the three states.

State Projects Coordinated

A research coordinator employed by the commission assists in coordination of the state research agencies, elimination of gaps in the work and in the development of joint programs of management which can be applied along the entire Pacific Coast of the United States and including Canada and Alaska when possible.

During the biennium, the Pacific Marine Fisheries Commission has coordinated research work on various ocean species conducted by the three states, Canada, Alaska, and the U. S. Fish and Wildlife Service. The work has included studies on the king and silver salmon, albacore, sablefish and the otter trawl fisheries. Accounts of the commission's work appears throughout this report under the species above-named.

THE SPORT FISHERIES

Marine sport fishing continued to show interesting changes during the biennium. The widely distributed rockfishes of the genus Sebastodes assumed a statewide importance never equaled before.

Even in Southern California, where the traditionally important barracuda, white seabass and kelp bass have held popular sway for many years, rockfish produced from 30 to 50 percent of the total catch. In the northern part of the State, salmon continued to provide increasing sport.

PARTY BOAT FISHING

Sport fishing party boats are increasing in number in the northern part of the State. In former years, there were three boats in the south to one in the north; now the ratio is approximately one to one. There is still a big difference in the relative sizes, as the southern boats average 18 anglers per trip as compared to nine for boats in the north.

Recent legislation in Congress aimed at improving the safety of the passengers on all manner of craft is expected to reduce sharply the number of active sport boats in California waters.

The increase in the southern rockfish catch indicates one or more conditions. Fishing success for the more popular game fishes has been decreasing, causing a search for substitutes. Rockfish are abundant and easy to take and very naturally fall into the void catches. Secondly, some evidence points to a possible extension of some cold water species to the south. This means that rockfish may be present in locations that were previously unproductive.

Salmon fishing from skiffs, like the one below, in Monterey, grew in popularity during the biennium.
(Fish and Game Photo by C. H. Meacham)

Party Boat Catches

Year	Rockfish	Salmon	Albacore	Kelp bass
1954	1,150,000	119,000	20,000	876,000
1955	1,737,000	129,000	79,000	497,000

The California halibut is one of California's popular game fishes, but this species has shown a marked decrease in numbers since 1950. Following the completion of the kelp bass study in the biennium, a tagging study to determine the growth and migration of the halibut was started in March, 1956. Three thousand of these fish were marked over a period of six weeks, mostly within the confines of the Long Beach-Los Angeles Harbor. Tagged halibut have been recovered by both commercial and sport fishermen, and the returns will be used as the basis for recommended management adjustments in the fishery.

SURF FISHING

The four most important species in the popular sport of surf fishing have been studied as a federal aid project. In order of numbers taken they are: the barred surfperch, the California corvina, the spotfin croaker (the latter two in almost equal numbers) and the yellowfin croaker.

Work on the barred perch is nearing completion. The fish of this species have been aged, a food study has been completed, as have fecundity and maturity studies. Tagging will be completed soon and an analysis of movement patterns compiled.

Volunteer records from surf fishermen and a monthly survey and creel census, conducted for one year, have yielded much data on catch per hour, the importance of each species in the catch, seasonal fluctuations in catch and the geographic distribution of the surf species.

Over 11,000 fish of the four project species were evaluated. Of these, 7,000 taken by beach seine provided the material needed for the various aspects of the study. Over 3,500 fish have been tagged, with about a 5 percent tag recovery.

The summarization of data obtained on the three species of croaker is continuing with considerable portions of the study completed.

Maturity studies, relationship of abundance and movement of the fish to tidal and seasonal cycles, and tagging analysis have been made on these fish. Observation of underwater conditions in supplying information to round out the picture. When completed, the analysis of the fishing and life histories will serve as the basis for a factual management program.

YELLOWTAIL

Yellowtail tuna, range from Central California (Monterey Bay) south along the Baja California coast and into the Gulf of California. They are most abundant between Sebastian Viscano Bay, and Magdalena Bay, Baja California, where they may be found all year around. California is on the fringe of the population.

That a large part of the population moves freely up and down the west coast of Baja California has been demonstrated by 96 of the 341 returns from 15,116 fish that have been tagged and released. These fish all moved between 50 and 360 miles from the locality where they were released. Movements of less than 50 miles were shown by 224 recoveries and migratory patterns show that yellowtail go north during the spring and summer and south during the winter. Few yellowtail remain in California waters during the winter, thus good angling for this species is dependent upon the success and strength of the migratory movement out of the Mexican wintering grounds.

That yellowtail tuna are all part of one homogeneous population has been shown by studies of body proportions and counts. Fish from all parts of their range have been compared and no significant differences were found.

Sport Fishing Increasing

Recreational fishing during 1955 was good, with 36,468 yellowtail as the reported catch. This compared to the postwar average of 30,386 fish per year by party boats. High catch vulnerability of yellowtail in areas heavily exploited by anglers has been demonstrated by the high rate of tag returns in such areas.

Commercial yellowtail fishing, on the other hand, declined to a meager 164,000 pounds in 1955, the lowest commercial catch made since 1916. This decline is the result of lack of market demand and not shortage of fish.

The commercial yellowtail fishery is now regulated by laws and additional restrictions are unnecessary in view of the poor market condition and the biological facts concerning its life history and migrations.

Progress toward the objectives of this federal aid project have been achieved; the tagging, statistical and most other studies are finished. Nearly completed are studies of food, age and growth, maturity and fecundity. Final preparation of the report of this project is being made and upon its presentation the project will be terminated.

SALTON SEA

The Salton Sea Project, conducted under contract with the department by the University of California at Los Angeles, with Wildlife Conservation Board funds, progressed exceedingly well and with good results being made toward the establishment of a sport fishery in this body of water.

California corvina being tagged by department personnel.
(Fish and Game Photo by Charles F. Crawford)

Project personnel, working from a headquarters established at Fish Springs, Salton Sea in 1954, have been successful in studying conditions at the sea and determining much of the potential that exists there. Physical and chemical factors have been carefully investigated and indicate that the life expectancy of the sea (for a sport fishery) should be at least 30 to 40 years.

An extensive "dead" area (lacking oxygen) has been located over much of the bottom of the sea that lies below 30 feet. This involves about 15 percent of the total area of the sea, but it is anoxic continuously only during the hot summer months. All of the organisms, living in this area during these prolonged periods when oxygen is lacking, die off and are not replaced until cooler winter months when oxygen again becomes available at these depths.

Worm Is Key to Life Cycle

The polychaet worm, *Neanthes succinea,* has been determined as the most important invertebrate in Salton Sea. The entire fish population, with the exception of the threadfin shad, is dependent upon it for food. Studies have been made upon the barnacle and various planktonic forms found in the sea. Their importance in the sea's development has been investigated.

Of the various fish species now found in the sea, life histories and food habits have been determined when possible. In September, 1955, the threadfin shad was first taken in Salton Sea and the species has since been captured at a number of widely scattered localities throughout the area.

Many Corvina Present

In the early summer of 1956, personnel investigating the covina in Salton Sea, estimated some 100,000 of these fine game fish inhabit the inland body of water. These represented four year classes that had successfully hatched in the sea, the oldest of which

had attained weights exceeding 18 pounds by midsummer 1956.

Fish and invertebrates planted by the department in Salton Sea to date include: 1,659 shortfin corvina, 63 orangemouth corvina, 2,500 anchovetas, 3,000 mysids (small shrimp-like creatures) and 500 polychaet worms.

THE SHELLFISHERIES

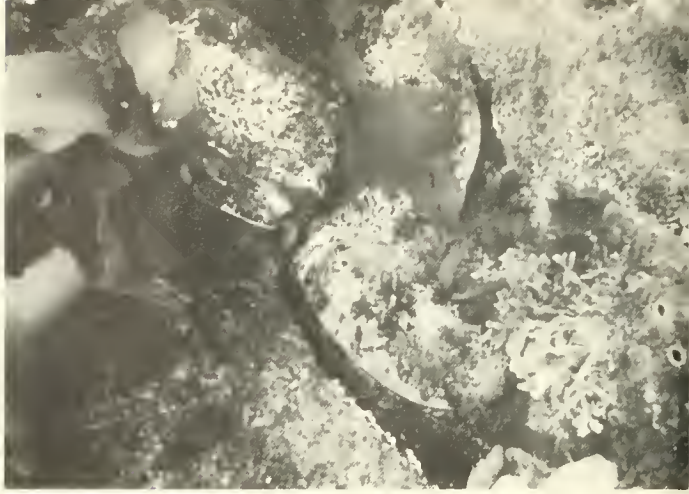
The total commercial abalone catch, while declining slightly from the previous biennium, is still running better than 4.1 million pounds per year. Almost the entire catch is composed of two species of abalone, the red, of which the majority are taken in Central California, and the pink, which comes from the Channel Islands off Southern California.

The Channel Islands off Southern California were not opened by law to commercial diving until 1943 and the fishery there did not get under way until 1947. Prior to that time almost all the take consisted of the red abalone from Central California. By 1949 almost 50 percent of the total catch was pinks, increasing each year to over two-thirds of 1953's 4.7 million pounds.

RED ABALONE

Since 1949 the pinks have shown a decline but the production of reds has remained relatively steady. Although this decline affects the income of the abalone industry it does not mean that the pink abalone population is in danger. The take appears to be leveling off. Most of the older individuals have been harvested and now the fishery depends more on the production of the younger abalone which have grown to marketable size. As the remaining older individuals

Department's biologist diver coming aboard after collecting sample of abalone (in net basket on deck) from ocean bottom near Ft. Bragg.
(Fish and Game Photo by Glen Bickford)



Underwater photograph taken by a department diver of five red abalone in natural habitat. The two abalone at the top of the photograph are feeding on seaweed.
(Fish and Game Photo by Glen Bickford)

are harvested, the catch will probably drop somewhat below its present level.

This stabilization has been reached in red abalone production at about 1.5 million pounds per year. Since 1949 the annual catch of reds has been between 1.2 and 2 million pounds.

The San Simeon-Morro Bay area, from which most of the red abalone come, has been in almost continuous production since 1929. Abalone in this area have a rapid growth rate and in most years the majority of those which reach legal size are to be harvested. The bulk of the shellfish appearing in the catch are young, tender abalone of the highest quality and command a premium price.

Because of the price difference between reds and pinks many of the Southern California divers moved into the Morro-San Simeon area during spells of good diving weather, but moved back as soon as the weather got rough.

Abalone Study Conducted

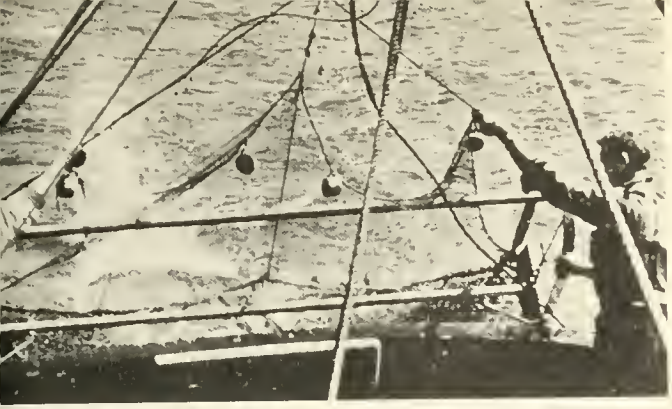
Whether a commercial abalone fishery could be established north of the Golden Gate was the subject of an investigation during the biennium.

Almost the entire red abalone population of the north coast is located close to the shore line and in relatively shallow water. Few, if any, are found beyond 50 feet in depth.

Representative sections of the northern coast line were examined during the study. In some small areas observed abalone were found in local abundance, but with few exceptions were small, their growth rate slow and their meat was generally of inferior quality. In many places there were very few abalone above the eight-inch legal size limit required for reds.

Nowhere among the sections observed were abalone found in sufficient numbers to support a sustained commercial fishery, as it currently is sustained on the southern coast of the State.

Transplanting operations have been conducted with red abalone to determine if this species can be introduced into apparently suitable areas where they are



Bringing an eight-foot beam trawl aboard the department's research vessel Nautilus. This gear plays a major role in sampling the juvenile crab population.
(Fish and Game Photo by W. A. Dahlstrom)

not present, or if the population can be built up in places where they are relatively uncommon. Results of the transplants were not determined at the end of the biennium.

MARKET CRAB

Many years ago the research on crabs led to sound conservation regulations. As a result a valuable resource thrived during years of intensive harvesting.

However, conditions in the crab fishery changed during the last few years and it was necessary that the fishery be re-evaluated. The results of studies, coupled with the cooperation of the crab industry, brought about changes in the crab laws in 1955 in which the season was shortened and provision was made for openings in crab traps through which many undersized crabs could escape.

The 1955 Legislature requested additional investigation to further improve conservation and management of this fishery.

The research is determining the effects of intensive fishing on the resource. Observations are being made of commercial fishing operations and the catch at Eureka and San Francisco. Records are made of the sizes and sexes of crabs taken and released aboard the fishing vessels as well as those kept for marketing. Study of juvenile crabs is being conducted to determine the factors causing strong and weak years of survival which result in years of relatively high and low harvest.

Escape Openings

Studies conducted aboard department research vessels and from commercial vessels revealed the value of escape openings for small crabs. Approximately 20 times as many crabs (mostly females and small males) are held in traps with no escape openings as are held in traps with four-inch circular openings providing an exit for the smaller crabs.

The natural movement of market crabs is being investigated by department scientists through tagging studies initiated in the San Francisco-Bodega region during October and November, 1955. Recoveries made during the 1955-1956 season showed movements of only a few miles from points of release with a general seasonal migration toward deeper water as the season progressed. Similar tagging work was being followed in the Eureka-Crescent City area prior to and during the 1956-57 season.

Record Seen Possible

Landings of market crabs leveled off at 7,000,000 to 8,000,000 pounds for the three years following the high of 13,000,000 pounds in 1952. However, the 1955-56 season landings indicate that the total landings for 1956 may approach the high level of 1952.

In the San Francisco area the market crab catch has remained relatively stable with annual landings of from 4,000,000 to 5,000,000 pounds for the past eight years. The drop from 1952 to 1955, was due to a decrease in north coast landings which hit a low of about a million and a half pounds in 1955. This year (1956), the landings in the Eureka-Crescent City area have skyrocketed upward to almost five times that recorded in 1955.

OYSTERS

During 1955 the oyster fishery saw the greatest activity since 1942, and 1956 figures may be even higher. Landings of Pacific oysters in 1955 very closely approached the all-time high of 1.7 million pounds of 1941. Oyster culture allotments for over 5,000 acres have been issued by the department since 1954, bringing the total area under oyster cultivation to nearly 14,000 acres.

The 1955 Legislature adopted extensive changes in laws governing shellfish culture. Fish and Game Code sections were updated to include license fees, privilege taxes and rental fees to be paid by shellfish cultivators. Support of the oyster industry and organized sportsmen helped to bring these changes about.

Regulations were amended by the Fish and Game Commission. These regulations now prescribe minimum use of state water bottoms allotted for oyster culture and provide for expedient inspections of shellfish shipments destined for planting in California waters.

Cases of seed oysters on pieces of shell are imported from Japan. The ship is hurriedly unloaded so that the valuable seed can be planted in California bays.
(Fish and Game Photo by H. G. Orcutt)

Seed oysters attached to pieces of shell are scattered on tidal flats.
(Fish and Game Photo by H. G. Orcutt)

Reason for Imports

Temperature and salinity conditions do not reach the proper level for a long enough time ordinarily to permit spawning of imported oysters in the water of our bays. However, this seeming shortcoming is more than overcome by the abundance of food organisms in these bays and the very favorable environment for adults.

This results in a very fast growing, meaty oyster, with prime quality and flavor much in demand by the oyster-consuming public.

The Pacific giant oyster is the principal product of the California industry. The young seed oysters are imported from Japan and grown in our bays to meet the great consumer demand in San Francisco and Los Angeles. This market is large and is expanding to include special canned and frozen products.

California oystermen enjoy remarkable production from their plantings. They have a crop ready for market in 14 to 20 months from time of planting seed. This is a year shorter than the time required in Washington state and two years shorter than that required in Japan. The shipments of seed oysters from Japan have increased tremendously during recent years.

With such phenomenal increases in seed plantings, a corresponding increase in landings can be expected. The accumulating effect on landings can be seen in the "Oyster Imports and Landings" table in this section.

New Methods

With the re-establishment of the industry in 1952, Morro Bay culturists took the lead in oystering by introducing methods in California to yield greater landings per unit of area farmed. During the 1954-56 biennium, Humboldt Bay operations have proceeded from test plantings to large scale oystering with highly specialized equipment. A modern hydraulic harvesting dredge, a large shucking plant and a new cannery are now in operation where in 1954 there was only the encouragement from results of test plantings.

Many thousands of acres of the largest bays— San Diego, San Francisco, San Pablo and large portions of Humboldt Bay—cannot be certified by the Department of Public Health for oyster production because of the possibility of contamination by sewage discharges.

This boom in shellfish production is now limited to areas presently in production and no further expansion is possible under present physical conditions.

Just Like Farming

Oyster culture is much like farming. The seed oysters attached to pieces of empty shells are planted on the tidal flats. Then the growing oyster is cultivated and fattened for harvest.

The valuable seed, most of which is shipped here from Japan, is inspected for pests before planting. Certain types of marine snails are the oyster's worst enemies. They drill holes in the shell, killing the oyster and feeding upon the delicate meat inside. Department inspections provide a protection against contamination of our California bays with pests from incoming shipments.

Native oysters, while they provide a particularly tasty meat, are not harvested commercially principally because labor involved in removing shells from meat is too costly.

Pollution Hurt Industry

The oyster industry in San Francisco Bay was at its height around the turn of the century. Even then, the oysters described by author Jack London in his story on raids on the oyster beds were not the native variety. They were imported here from the East. The industry reached a peak of over 1.5 million pounds harvested annually by 1911, then faded away because of

Oyster Imports

Season	Cases*
November, 1951-April, 1952	1,530
November, 1952-April, 1953	2,530
November, 1953-April, 1954	2,234
November, 1954-April, 1955	10,800
November, 1955-April, 1956	26,581

* Cases of seed oysters imported from Japan weigh approximately 200 pounds apiece.

. . . and Landings

Year	Pounds
1951	133,700
1952	188,655
1953	161,520
1954	458,493
1955	1,535,067

Unloading part of a day's catch of ocean shrimp at Bodega Bay.
(Fish and Game Photo by D. W. McFadden)

polluted conditions of much otherwise usable area. Only in the last decade has it been revived.

OCEAN SHRIMP

The infant ocean shrimp fishery of 1952 continued to grow this biennium. This relatively new commercial fishery was established as a result of exploratory and development work of the Marine Fisheries Branch.

Production grew from 206,000 pounds in 1952 to 300,000 in 1954. In 1955 a total of 855,000 pounds of ocean shrimp was taken in California waters, of which 501,000 pounds were landed in Crescent City. Bodega Bay shrimpers brought in 330,000 pounds but only 1,446 pounds were delivered in Morro Bay.

The shrimp yield through June 30, 1956, was 419,000 pounds, which represents a 22 percent increase over the amount landed in a similar period in 1955. The Crescent City shrimp fleet again led production with 308,000 pounds, whereas Bodega Bay fishermen caught 111,000 pounds. As a conservation measure the Morro Bay area was closed in 1956 to commercial shrimp fishing by the Fish and Game Commission until such time as the shrimp stocks in that area reach a safe harvestable level.

Mesh Experiments

Shrimp net mesh testing experiments were conducted at sea aboard the *N. B. Scofield* in 1956. Further mesh size testing is scheduled in 1957 to obtain sufficient data to establish the optimum mesh size for commercial shrimp net regulations.

Through the cooperation of commercial fishermen, many samples of the shrimp catch were taken in the Bodega Bay and Crescent City areas for size composition analysis.

A study of the growth rate and sexual maturity of the ocean shrimp has been completed under direction of the department.

PISMO CLAMS

From the annual Pismo clam censuses conducted in the winters of 1954 and 1955 at Pismo Beach and Morro Bay, it has been determined that the number of clams available to the average digger will be in short supply within the immediate forseeable future.

From these and previous censuses it is obvious that clam recruitment at Pismo Beach has been extremely poor since 1947, while at Morro Bay no worthwhile sets have occurred since 1944.

Because it takes from 7 to 10 years before most of the clams from any particular year class attain the legal size of five inches, there will be a period of several years (from the time the present supply runs out and until a new set attains legal size) when clam digging will result in an extremely poor yield.

At no time during the history of the Pismo clam census (since 1923) has there been such a prolonged period of poor setting.

Causes Unknown

Cause or causes of poor survival are unknown but could be attributed to a number of factors such as adverse currents, rapid temperature changes at a critical period in larval development, salinities unsuitable for successful setting, and extreme predation during larval stages.

PELAGIC FISHERIES

California fishermen exploiting the tuna resources of the eastern Pacific Ocean range from British Columbia to Peru in quest of their quarry. The fishermen utilize three types of gear in taking four different species of fish.

Albacore, erratic in occurence and numbers, are taken seasonally from June to November by small vessels using trolling gear in the temperate waters from central Baja California north to British Columbia. Yellowfin and skipjack are fished throughout the year by long ranging bait boats and purse seiners from Baja California south to Peru.

Bluefin tuna are sought commercially only by purse seiners because of their dense schooling habits and reluctance to bite at lures. Bluefin tuna are the mystery fish of the group, for the least is known about them.

TUNA PRODUCTION

Prior to 1924, the industry averaged about 25,000,000 pounds annually. Since that time there has been a steady increase as markets developed with greater acceptance of the product.

The problems of the tuna industry during the biennium were of a complex nature, centering primarily about the high cost of domestic production and stiff competition from foreign producers. Readjustments were manifest in cutbacks in the price of raw fish and in the over-all reduction in volume. The latter was accomplished by intricate rotation systems for vessel

unloading and departure times for succeeding trips, thus effecting a reduction in the total number of trips and the total tonnage.

Solutions to the industry's problems were sought on all fronts, from intensified advertising campaigns to seeking governmental aid via direct subsidy and/or tariffs. Efforts were not without some reward, particularly in the increase of consumption.

The ultimate objective of the department's tuna investigation is the same as for other fisheries under study by the Marine Fisheries Branch. That is to obtain necessary information on which to base recommendations for such management of marine life as is necessary to allow a continued harvest at the highest possible level. This requires determinations of the size of the stocks, fluctuations in abundance, levels of exploitation, etc. Tuna research activities during the biennium were directed toward the solution of these problems.

Tagging Program

The full scale tagging program, initiated during the preceding biennium, was actively carried forward during this one. Eleven tagging teams sailing on as many commercial fishing vessels, liberated over 6,200 tuna with the department's originally designed tags of white vinyl plastic tubing.

Tuna fishing from the stern of a modern tuna clipper in the eastern tropical Pacific Ocean. Eleven teams from the department tagged tuna aboard such vessels during the biennium.
(Fish and Game Photo)

Accumulated tag return data are beginning to unfold the patterns of movements of yellowfin tuna and albacore. The trans-Pacific migration of albacore was further substantiated by additional recoveries in Japan. Yellowfin were shown to move from southern Mexico northward to central Baja California, gross movements of almost a thousand miles. These movements hint at a link between the fish off the so-called "local" grounds, Baja California, with those occurring off Central America. Skipjack returns to date indicate that additional developmental work is needed before returns can be expected which will yield the necessary data for management recommendations.

The fish market sampling program, a long term project, undertaken by the department, is designed to yield a maximum amount of information regarding the populations of the various tunas. By interviewing the fishermen, details of the catch in time and area are obtained. By measuring the lengths of the fish in the catch, information is obtained on their age, rate of growth and variation in abundance. For the yellowfin-skipjack fishery the gathering of this data was done on a cooperative basis with the Inter-American Tropical Tuna Commission, effecting a saving in manpower for both organizations. Substantial progress was made in compiling the length frequencies for analysis which was started late in the biennium.

Log Books Help

The use of log books is an invaluable tool in the study of fishery population dynamics. During the biennium a chart type log book was designed for the albacore fishery. The promising results obtained from the pilot trial late in the 1954 season encouraged the planning and initiation of a full scale program in 1955. The first season's returns, 1955, produced a response of 55 percent of the fishermen. The data obtained yielded one of the most complete pictures of the albacore fishery off California shores ever compiled.

Field work at sea on survey vessels or from commercial fishing boats yields types of information not readily obtainable by other means. The occurrence of tuna in time, distance and depth, in areas and seasons not normally covered by the fishery is a case in point; measurements of the environment is another. Because costs are high, each cruise is designed to answer as many questions and problems as is practical. The department's survey vessel, *N. B. Scofield*, made three exploratory fishing cruises for tuna during the biennium. A fourth cruise was made by department personnel on the University of California's research vessel, the *Paolina T.*

Albacore

The albacore is the only tuna that is taken in numbers north of California. The three states, Canada, and the U. S. Fish and Wildlife Service have all studied this species. There is vital need for these studies to

be properly coordinated and the Pacific Marine Fisheries Commission has accepted the responsibility for this job, and is continuing to act as the clearing house for the exchange of albacore data among the interested agencies.

SARDINES

Sardines, virtually absent during 1952 and 1953, again appeared in Southern California waters. California's purse seine fleet took 64,000 tons during the 1954-55 season and 75,000 tons in the 1955-56 season. These landings, although a sizable increase over the two previous years of complete failure, were a far cry from even poor seasons during the "hey day" of the fishery. Optimism expressed in some quarters that California's sardines have once again returned home is not justified by the available evidence.

Historically, from 1916 to the present, the California sardine industry has depended upon rather predictable on-shore movements of adult fish after their off-shore spawning. During the peak of the industry this spawning occurred as far north as British Columbia. After spawning, the adult fish moved in-shore and traveled south along the coast at which time they were available to the purse seiners.

With the series of poor spawning years beginning in the late 1940's, coupled with a continuing heavy fishing pressure, the stock of fish north of Baja California was reduced progressively each year. The pinch was felt first in the north where the largest oldest fish were normally taken.

The fisheries in British Columbia, Washington and Oregon failed in the late 1940's and by 1951, Monterey's once large industry was no more. By 1952 the San Pedro fishery was almost as completely dead as Monterey's.

A purse seine net puller, developed and patented during the biennium, enables the fisherman to purse and pull an empty net in as little as 15 minutes, a task that formerly required as much as three hours.
(Fish and Game Photo by Anita Daugherty)

Live Bait Catch

Area (for 1955)	Daily reporting bait boats	No. pounds of live bait*	No. of angler days by area (sport-fishermen)**
Port Hueneme to Morro Bay	5	645,353	39,576
Santa Monica Bay	3	1,220,154	57,295
Los Angeles and Long Beach Harbor	7	4,712,843	101,601
Newport to San Clemente	4	1,418,304	57,664
Oceanside to San Diego	3	4,488,927	91,766
Totals	22	12,485,581	357,902

* Including sardines, anchovies and young of other fish.
** These figures include Party Boat and Charter Boat Anglers only.

No Mexican Shift

The California fish did not travel away from California waters to other geographical areas. There was no compensating increase in Mexico's sardine population to indicate that the sardines shifted bodily to the south. California sardines no longer existed, except in cans, meal and oil.

Then in 1954 and again in 1955 fish from Mexico shifted northward and spawned as far north as Point Conception. By the time these Mexican fish moved inshore and south the fishing fleet was ready for them, even before they had spawned. Boats from the idle Monterey fleet moved south and joined the San Pedro boats. Airplane spotters had now joined to help the fleet and fish were taken both day and night.

As yet there is no evidence that California's sardine population has become re-established. The young fish spawned in California waters by Mexican fish in the last two years do not appear yet to constitute even average size classes for this region. There have been no outstanding or even good spawnings of sardines in Baja California to compensate for the loss of California's fish. Actually, the sardine population for the coast as a whole is probably now not far above its lowest level.

Sound Conservation Needed

It becomes abundantly clear that sound conservation practices are needed in the sardine fishery if ever these fish are to return to their former abundance and range. Until the catch is limited to a reasonable percentage of what is available and until nature provides conditions for good spawning survival the fishery cannot improve substantially. The Pacific Northwest and even Monterey can expect no great fishery until California's offshore spawning population is once again re-established.

During the biennium the California Cooperative Fishery Investigation research team has greatly in-

creased knowledge and understanding of the sardine. Research techniques developed by the department's Marine Fisheries Branch as well as the other cooperating agencies have begun to pay real dividends. A combination of egg and larvae surveys as well as preseason censuses on young and adult fish along the coast have contributed to very accurate catch predictions for the past three years. The research methods used in the investigation of the sardine have become models for fisheries investigators throughout the world.

Airplanes Aid Biologists

In addition to the routine young and adult fish surveys along the coast the Marine Fisheries Branch has begun to use department airplanes to aid the shipboard biologists locate and assess fish concentrations. As a further aid in collecting fish samples at sea, the branch has been developing electro-fishing devices for the attraction and capture of samples of fish. Although this work is still in the developmental stage, the results thus far have been most encouraging.

MACKEREL FISHERY

During most of the biennium landings of Pacific mackerel and jack mackerel were almost completely respondent to market demand. Except for the first few months of the two-year period when there was an actual shortage of both species in local waters, the supply of mackerel seems to have exceeded the consistently poor market demand.

Before the opening of sardine fishing in October of 1954, and following two years of complete sardine failure, fishermen were receiving as high as $85 per ton for Pacifics and $80 per ton for jacks. By 1955 the price had been reduced to $45 and $42.50 respectively and landings were held down by lack of orders and cannery-imposed tonnage limits for each boat.

This failing market for canned mackerel is attributable to several obvious factors. In former years the product, inexpensively processed and marketed, provided a cheap protein food for the lower economic groups in the United States and was well received in many countries of the Far East and South America. Since the steady rise of the American standard of living those families who may have bought canned mackerel not out of choice but rather out of necessity can now afford meat or more expensive fish products. In the face of this diminishing domestic market has been the steady rise in costs for the canner and a serious increase in foreign competition for overseas markets.

Competition Tough

South African processors can deliver canned mackerel to the Orient at a much more attractive price and the product is equal to the U. S. product in every respect. Until U. S. canners can make canned mackerel more attractive to the American consumer or devise means to meet foreign competition the industry will continue to be in a difficult condition.

Blanket net used by research vessels in obtaining samples of anchovies, sardines and mackerel. Used at night, the fish are attracted to the area by the suspended light.
(Fish and Game Photo by Robert Collyer)

In the case of Pacific mackerel, market conditions have had a profound effect on survival of the small one- to three-man scoop boats. This fishery which once supported hundreds of independent fishermen and from 1939 to 1952 supplied more fish than the purse seine fleet, is virtually nonexistent. The market is now easily supplied with all the fish needed more economically and often in better condition, from the purse seine fleet.

Prior to the 1954-55 season there was serious concern over the diminishing stocks of Pacific mackerel. The fishery was becoming more and more dependent upon the success of incoming year classes. The backlog of older mature fish in the population was at a seriously low level. Since 1947, between one-third and one-half of the total number of fish contributed by any single year class were captured before they had reached an age of two years and sexual maturity. Only seven-tenths of 1 percent of the 44,800,000 fish caught during the 1954-55 season were older than 36 months.

Market Decline

The recent decline in market demand for mackerel may well prove to be the major factor in any future increase in the size of the Pacific mackerel population. The 1953 year class, which has dominated in the catch since before they were a year old, has been a rather successful one. These fish, since the demand on them is now low, are expected to reproduce successfully in numbers for future generations.

Expanding knowledge on the jack mackerel indicates that this fishery is not now and has never been seriously threatened by man's demands. It has long been known that these fish which most commonly enter coastal waters—the two, three, and four year olds—represent only a fringe of the population. Enough isolated catches of very large old fish were taken annually by both purse seiners and sport anglers to show that there is a residual stock of mature fish beyond the range of the fishery. Recent evi-

dence, eggs and larvae, gathered from plankton hauls off the Pacific Coast show that jack mackerel spawn in excess of 1,000 miles off shore.

THE ANCHOVY

Prior to World War II the anchovy in California was utilized primarily for live or dead bait. As a product for human consumption the demand for the species was negligible. However, beginning in the late 1940s and stimulated by the failure of the sardine fishery the demand for a "substitute sardine" rose sharply.

From a prewar annual average of much less than 1,000,000 pounds the commercial landings of anchovies rose to a high of over 84,000,000 pounds in 1953. This take, coupled with live bait landings in excess of 16,000,000 pounds led to serious concern by sportfishing interests that the anchovy, if open to unlimited demand, would go the way of the sardine.

Commercial Take Down

In 1954 and 1955 the commercial landings dipped to 42,000,000 and 45,000,000 pounds respectively. This decline was primarily due to a lessening market demand for the species. In spite of considerable effort on the part of industry to develop a low cost attractive product, worldwide competition had increased to the point where inventories had piled up faster than they could be profitably sold. In addition the return of even small numbers of sardines in 1954, and 1955 had decreased the demand for anchovies.

In view of this lessening demand for anchovies and under a continuing pressure for some restrictive measures, the Legislature, in 1955, enacted the fol-

Men Again Hunt the Biggest Game of All

This biennium saw the rebirth of a fascinating California whale fishery. Once again seafarers have put to sea to chase the elusive leviathan of the deep.

But when the cry of "Whale Ho!" sounds over the deck of the modern whaling vessel, it is sung not from the briny lungs of some ancient mariner but from the scratchy, impersonal vocal cords of the ship's electronic intercom system.

Progress, alas, is inevitable. The sailing ship of old has been replaced by converted World War II navy vessels, manned by relatively small crews of five men. At present there are two licensed whale catchers working out of San Francisco Bay. The *Dennis Gayle*, which formerly based at the Fields Landing station, and the *Donna Mae* began operations in the spring of 1956. Reports revealed good catches as the biennium ended.

The hand harpoon has gone the way of the sailing ship. Today's harpoon consists of a 175-pound shaft tipped with an explosive grenade-type head fired by a powerful gun mounted on the bow of the catcher boat.

While the minimum size of an ordinary fish is usually expressed in inches, the minimum size of the sperm whale (the whale of Moby Dick fame) allowed by the International Whaling Commission, is 50 feet. The legal minimum size of the more common humpback whale is 35 feet. A humpback whale of legal size would weigh approximately 25 tons. It is interesting to note that whaling crews are paid for their catch by the linear foot rather than by gross weight.

After these large mammals are towed into the whaling station at Point San Pablo, they are winched onto a flencing deck. Each animal is measured and stripped of its blubber (which is approximately one foot thick, depending on the size and condition of the whale). This is done by crews of flencers armed with large machete-like knives. The whale is then decapitated and "filleted." Portions of the loin are used for animal food.

Horpoon connon mounted on bow of whale killer vessel, Dennis Gayle.
(Fish and Game Photo by J. B. Phillips)

The meat of the humpback whale is palatable and the taste not unlike that of beef. The carcass is ultimately rendered down into oil, fertilizer and bone meal.

The catcher boats and the land stations expect to catch and process from one to four whales a day during the whaling season. The first catch, made on May 9th, was a 36-ton humpback whale. In addition to utilizing the whales for meal and oil, it is believed that suitable parts of the whale meat will be chopped and frozen for mink or other animal food. This venture is the first attempt to catch and process whales in the United States since 1953.

For catchers attached to land stations, the open season for baleen (blue, fin, humpback, sei, or minke) whales is May 1st - October 31st and for sperm whales April 1st-November 30th.

Herring fishing with a beach seine near Marshall, Tomales Bay.
(Fish and Game Photo by J. B. Phillips)

lowing: "During the period from September 1, 1955, to March 31, 1956, the total amount of anchovies which may be taken or received for canning, including canned pet food, shall not be more than 21,000 tons. During the period from April 1, 1956, to March 31, 1957, the total amount of anchovies which may be taken or received for canning, including canned pet food shall not be more than 35,000 tons."

In addition to this regulation on total catch, legislation was enacted to protect the young anchovy. The law now declares: "No anchovies less than five inches in length measured from tip of snout to tip of tail may be purchased for any purpose except for use as bait; provided that the allowable percentage of undersized anchovies which may be contained in any load or lot purchased shall be not more than 25 percent by weight of all anchovies in said load or lot."

This and similar legislation on the California yellowtail mark the first time that total annual bag limits have been placed on any commercially taken California marine fish.

New Techniques

During the biennium new techniques were instituted to maintain a close check on the relative health of California's anchovy population. Since 1955, weekly samples of bait have been collected from the major sportfishing landings from Morro Bay to San Diego. Length frequency and age analyses of these samples have been found to reflect accurately the sizes and ages of the bait utilized throughout the year along the coast. Valuable information on the relative strength of incoming year classes in Southern California will now be available.

In former years, young sardines formed an important portion of the California live bait catch. The bait sampling program will also lead to accurate estimates of the relative numbers of juvenile sardines which move inshore each year to the Southern California nursery grounds.

In addition to the bait sampling program, and perhaps more spectacular, is the recently instituted series of airplane spotting flights designed to assess the abundance and distribution of anchovies as well as sardines and mackerel in coastal waters. Although still in the developmental stages, this program of identifying and estimating abundance of various pelagic species shows great promise, both as a supplement to vessel surveys as well as a new research tool of its own.

PACIFIC HERRING

The Pacific herring fishery has always been of relatively minor importance in California. But, with the "disappearance" of the sardine from the coast of California, attention has been focused upon all other pelagic species, the Pacific herring not excluded.

The herring catch that had remained around 300 tons yearly from 1920-1947 rose sharply to over 4,000 tons in 1948. From 1948 to 1956 the catch fluctuated widely. As the abundance of sardines and other pelagic fishes diminished, the demand for herring rose; and when other more preferred species, such as the anchovy and mackerel were abundant, the demand for herring decreased. The peak catch of herring came in 1952 when over 5,000 tons were landed.

Unfortunately the herring processed for human consumption met serious sales resistance. Adult herring become soft and do not process well when subjected to cooking pressures and temperatures. As soon as this was discovered, several members of the industry applied to the Fish and Game Commission for permits to reduce herring into meal and oil.

Short Term Study

Very little was known about the status of the herring population in California so, in 1954, the commission ordered a short-term intensive study. The information from this study would be used to determine whether reduction permits should be granted. The study was completed in 1955 and the results were published in early 1956. Generally the findings were as follows:

The herring population in California waters is of relatively small magnitude compared to the vast herring stocks in Canadian waters where from 100-200 thousand tons are taken annually. Estimates based on the numbers of eggs deposited by the total spawning population during the spawning season (January to March) in Tomales and San Francisco Bays indicated a total population of around 16,000 tons. Admittedly the data used to compute the California population are rough approximations, but the results do indicate a population of such small magnitude that excessive take of fish on the spawning grounds would threaten the resource.

Herring Easily Caught

Of primary interest in terms of management is the fact that prespawning schools of herring are easily caught in Tomales Bay. Boats equipped with round

haul nets are used in the deeper parts of the bay and fishermen using beach seines and gill nets operate along the beaches where the herring gather to deposit their eggs.

Herring entering San Francisco Bay to spawn, on the other hand, are much less vulnerable to fishing activity. Strong tides, tide rips, and rocky shore lines make it difficult for fishermen to catch the fish. The population entering San Francisco Bay to spawn was estimated to be about three times as great as the population entering Tomales Bay. Thus, even though the San Francisco Bay spawning population is much larger than the population entering Tomales Bay, increased markets for herring would bring about greater pressure upon the better fishery because of the easier availability of the Tomales fish.

All Year Fishing Pressure

Where adult herring go after spawning in San Francisco and Tomales Bays was not fully disclosed, but evidence indicates that considerable numbers concentrate in the Monterey Bay area upon returning to sea. In 1952, over half of the yearly tonnage was taken in the summer months in Monterey Bay. Thus, the adult herring spawning in Tomales and San Francisco Bays may be subject to fishing pressure all year round.

As a result of the survey, the commission refused to grant reduction permits.

MARINE RESEARCH COMMITTEE

In 1955 the Legislature changed the composition of the members of the Marine Research Committee, and the membership of the committee now consists of nine men, of whom five represent the production phase of the fishing industry, one represents organized sportsmen, and one represents organized labor.

Marine investigations carried on under the coordination of this committee were continued by California Academy of Sciences, California Department of Fish and Game, Scripps Institution of Oceanography, Hopkins Marine Station, and the U. S. Fish and Wildlife Service. Under this study oceanic phases of the pelagic fish, including sardines, mackerel, anchovy, herring and squid, were investigated, bringing together additional information concerning the pelagic marine fisheries of the Pacific Ocean.

Limited catches of the supporting fisheries continued during the period, with, a small increase in the catch of sardines.

BOTTOM FISHERIES

During the past two years the otter trawl fishery continued to produce the State's major source of fish for the fresh fish market. Over 30 million pounds of assorted bottom fish are brought in each year by California's trawl fleet. These landings have continued at this high level in spite of increasingly strong competition from imported frozen fish fillets.

Although there has been little change in the poundage of fish landed, there has been a marked change in the relative proportion of the various species in the catch.

DOVER SOLE

Dover sole is still the leading species, but bocaccio rockfish has increased rapidly and has taken second place from English sole. There has also been a marked increase in the combined landings of several other species of rockfish which are usually marketed together.

The relatively small fillet return from rockfish is offset by using the remainder of the fish as pet or mink food. The marketings of rockfish and flatfish "frames" along with varieties and sizes of fish now considered undesirable for human use, has made it possible for the trawl fishermen to operate at price levels which otherwise would be impossibly low.

Research by the department on bottomfish has included mesh studies to determine the sizes of webbing which will do the best job of retaining marketable sizes of fish and releasing those which are too small. Part of this work has been done as a cooperative study under the coordination of the Pacific Marine Fisheries Commission. The latest such experiment was performed in 1956 and was carried out by Washington State Department of Fisheries and California Department of Fish and Game men, working together on California's research vessel, the *N. B. Scofield.*

Sampling Program

A continuing program of sampling the trawl catch is being carried on at San Francisco and Eureka. Additional information is obtained from the daily log of fishing activity which each trawl fisherman is required to turn over to the department. These logs and records of the daily landings of each boat are collated and checked. The combined information obtained from these processes has served to keep the management of

A typical bag of bottom fish, invertebrates and debris taken during halibut tagging work near Long Beach.
(Pierpont Landing Photo)

this fishery in step with good conservation practices through knowledge of existing biological and industry relationships.

ROCKFISH

The rockfish or "rock cods" are abundant in California waters, wherein about 50 species are found. Adults of the many species of rockfish are taken from shallow water close to shore to well offshore and a depth of about 2,400 feet.

Some of the forms occurring in California are distributed from Lower California to Alaska, but others are more restricted in their distribution. A few species are small, hardly reaching 10 inches when fully grown, while some other species may attain a length of 36 inches. For the most part, rockfish are found off rocky coasts or over a rocky or gravelly bottom, but a few species occur over a hard sandy bottom.

Rockfish were of commercial importance in California as early as 1875. In 1900, the catch was between one and two million pounds. In 1918, the catch had increased to eight million pounds as a consequence of the increased demand for food during World War I. Following a postwar slump, landings increased to 13 million pounds in 1945, reflecting World War II demands. Following another postwar slump, the annual catch has fluctuated between 12 and 13 million pounds since 1953.

Sportsman's Take

During the past 10 years, sport fishing in ocean waters has become well established and rockfish are now an important component of this catch. Party boat catch records for all California reveal that in 1947 about 2½ million fish were landed by anglers, of which rockfish comprised about 10 percent; in 1955 slightly over three million fish were landed, of which half were rockfish.

In addition to the catches made from the several hundred party boats operating in California ocean waters, rockfish are also caught by anglers operating from motor boats, skiffs, piers, and shore and are also taken by skin divers.

Prior to 1943 most of the commercial fishery for rockfish was in southern and central California. The majority of the catches were made by means of setlines, a series of baited hooks attached to a long line. During this period only about 5 percent of the annual total was landed by operators of the old-type drag net that was rigged for catching flatfish on the bottom of the sea.

Dragnet Modified

Late in 1943 a modified version of the dragnet, designed for capturing rockfish, was introduced into Northern California. This modification, termed a "balloon trawl," proved so successful that by the end of 1944 most of the catches of rockfish were being made with this type of gear in northern and central California waters. Although dragnet gear is now accounting for the bulk of the rockfish landed in California, there are still a few small boats that fish with setline gear, particularly along the section of the Southern California coast where dragnets are prohibited.

A Eureka longline vessel, the Franz Joseph, drifting 10 miles offshore while fishing for sablefish.
(Fish and Game Photo by J. B. Phillips)

Frozen Fillets

For many years a large portion of the rockfish catch has been marketed in the form of fillets. During World War II the freezing of fillets was given a strong impetus because of military demands. A small portion of the catch is marketed in a fresh, dressed form. In previous years small amounts of rockfish have been salted. Experimental canning of rockfish has been tried but did not prove profitable.

SABLEFISH

Results of studies on the sablefish (black cod) which were carried on jointly by the fisheries departments of Alaska, Canada, Washington, Oregon, and California were published by the Pacific Marine Fisheries Commission in Bulletin 3, released late in 1954.

Sablefish form the basis of a minor but steady fishery along the Pacific Coast, primarily because of the popularity of the product in a smoked form. Since 1946, the average annual Pacific Coast landings have been about 10 million pounds, with California accounting for about 2 million pounds. The fishery is exploited by both longline (setline) and otter trawl (dragnet) fishermen.

Studies on the abundance of sablefish in California waters, based on an analysis of the commercial fishery, indicate that the catch per trip has continued to remain fairly constant since 1941. Fluctuations in seasonal catches are quite closely correlated with economic factors. Inasmuch as the greatest portion of the Pacific Coast catch is placed in cold storage for future smoking, a large cold storage holding in one year is associated with a relatively low catch in the ensuing year, and vice versa.

Because the return per unit of effort is being maintained and because there have been no new developments in the utilization of this species, further regula-

tion of this fishery in California is not being proposed, for the present.

Five-Way Study

Studies on sablefish were made by California, Oregon, Washington, Canada, and Alaska. Additional data was supplied by the International Pacific Halibut Commission. The work was coordinated by the Pacific Marine Fisheries Commission and culminated in the publication of the Commission's Bulletin 3. The work showed that the sablefish stocks are divided into several different populations, that California's populations appeared to be in good condition but that some of those farther north were not.

Boat catch studies conducted since the publication of Bulletin 3 have indicated that California's sablefish stocks are still in good condition.

RESEARCH VESSELS

During the biennium the *N. B. Scofield* completed nine cruises in 412 operating days. These cruises covered the coast between Vancouver Island, British Columbia and the Gulf of Panama and offshore to the Galapagos Islands on the equator. The vessel also worked as much as 500 miles offshore from Southern California.

Three trips were made into the waters off Mexico, and Central and South America to investigate subsurface populations of yellowfin tuna by means of long-line gear. Two other cruises, in which long-line gear was used, were made off the Pacific Coast to determine the albacore's migratory routes.

Three trips utilized trawl gear, two to investigate flatfish populations in the Northern California area and one to carry out exploratory work on shrimp off Central California. A cruise was conducted in Southern California waters to tag and release abalones.

Yellowfin

The Yellowfin completed 18 cruises during the biennium in 411 days of operations. All but two of these cruises were made to carry out pelagic fish investigations on the commercially important sardines, anchovies and mackerel. For the most part these investigations were made in the coastal waters of California and Baja California, between San Francisco and Magdalena Bay.

Yellowtail and abalone tagging were accomplished on the two "nonpelagic fish" trips. Pioneer experimental work in the development of electro-fishing collection devices were conducted aboard the vessel with excellent results. Fish were positively attracted from relatively long distances in salt water, presaging the advent of more efficient operation in marine surveys.

In May, 1956, extensive dry rot was found throughout the *Yellowfin*, rendering the vessel unsafe for further offshore biological research. It was removed from offshore service and preparation made to decommission and replace it.

Mollusk

The 26-foot diving boat *Mollusk* is designed for working close to rocks in shallow water where it can operate in rocky areas which would result in the destruction of less maneuverable craft. The boat has been used exclusively in the abalone investigation. Equipped with compressor, diving stage and ladder, deep sea diving equipment, hose and underwater telephone, it enables department personnel to work in comparative safety while conducting underwater surveys and operations.

Nautilus

The primary function of the *Nautilus* has been that of mothership and base operations for the abalone investigation. Because the *Mollusk* is small and has no accommodations to sleep or feed the necessary crew, the 50-foot *Nautilus* goes along whenever the investigation is so far from a port that it is not practical to return to harbor each evening.

The *Nautilus* is equipped with an electrical generating system which is used to supply the power for underwater lights used by personnel in the study of night time habits of abalone and for underwater photography. Occasionally, aqualung diving is conducted from the *Nautilus* but for the major portion of the underwater work conventional diving gear is used.

The *Nautilus* is well equipped for other investigational work and during the biennium was used in the following investigations:

Herring: The herring schools in San Francisco Bay were charted with the electronic underwater gear. Gillnets and blanket nets were used in sampling the herring schools.

Crab: Experimental crab traps were used to test the effectiveness of different sized escape openings for releasing undersized crabs. Beam trawls were used to collect crabs in the very small sizes.

Shrimp and Prawn: Shrimp surveys and some experimental fishing with prawn traps were carried on from the *Nautilus*.

Survey vessel N. B. Scofield is designed for use with many types of geor. (Photo by Claude M. Kreider)

SPECIAL ACTIVITIES

Increased services to the investigations of the department marked the 44th biennium in statistics. During this time, replacement and addition of business machine equipment enabled more detailed and more comprehensive analyses to be made.

Special tabulated reports of data, both biological and statistical, were prepared. Correlation of data from fish receipts, log books, questionnaires, and original source documents recorded by field scientists gave the basis for this information. Reports were likewise tabulated for the Inland Fisheries and Game Management sections.

The acquisition of newer, improved tabulating equipment permitted the absorption of these additional duties through more efficient and versatile operation.

Publications

The staff issued three publications during the biennium. Statistical Circulars Nos. 29 and 30 presented the annual statistics of fresh and canned fishery products for the years 1954 and 1955, respectively. Circular 30 had in addition a table of processed sport-caught fish—the first time sport processing has been separated in the records. Fish Bulletin No. 102 represented the complete commercial fish catch for 1953 and 1954, including the jack mackerel and sardine yield per area from California waters from 1946-1947 through 1954-1955, illustrated by charts, tables and accompanying text.

Since January, 1955, preliminary monthly landing figures have been published in cooperation with the U. S. Fish and Wildlife Service. This leaflet, recording preliminary figures, is printed in Washington, based on monthly landing figures supplied by the department and distributed both by the department and the U. S. Fish and Wildlife Service. Prior to this publication, state-wide monthly preliminary figures were not circulated.

Kelp

Early in 1955, the California Fish and Game Commission recommended the formation of a committee of persons interested in the kelp problem to consider the history and the future of the kelp resource and advance a program to bring about a concerted attack on the problem by all interested groups.

Two important results have come from committee efforts: (1) a working agreement between the kelp industry and the sport fishing industry was reached; (2) a five-year study of the relationships between fish and kelp, water conditions and kelp and other relationships has been set up with the University of California. Preliminary financing of this project is under contract with the department.

In the latter half of 1955 and the early part of 1956, the department resurveyed the commercial kelp beds off Southern California by airplane, with some additional check by boat and from shore. New maps were drawn and these were compared to maps made in 1912. Four categories were used to assist in the comparison: heavy, medium, thin, and gone. Of 44 beds thus compared, five showed no change between the two surveys, 17 had declined in abundance, and 22 improved. The beds which showed no change comprised 16 square miles, those which declined 35, and the improved beds 44 square miles.

A number of the beds have declined to the point where they are practically nonexistent. All of these beds that have practically disappeared are located in close proximity to sewage outfalls with discharges in excess of 40 million gallons per day. These include: two beds near the outlet of San Diego Bay, three off White Point, and two in Santa Monica Bay.

Seismic Explorations

Department of Fish and Game personnel observed all offshore seismic oil explorations conducted by use of explosives during the biennium and reported all observed damage to marine life.

Each seismic exploration crew is accompanied at all times by an official representative of the department, whose duty is to observe the operation and take whatever steps are necessary to keep damage to marine life to an absolute minimum. Companies holding seismic permits from the Fish and Game Commission defray costs of the department observers.

One seismic crew operating in Southern California waters from July, 1954, until March, 1955, detonated 1,382,826 pounds of black powder with an observed kill of 389 fish. A second, operating in the same general area between October, 1954, and May, 1955, detonated 1,148,985 pounds of black powder with an observed kill of 665 fish. No crews operated between May, 1955, and January, 1956. Seismic exploration recommenced in the Santa Barbara area in January with 632,070 pounds of black powder detonated between January and June, 1956. A total of 860 fish was the observed kill. A fourth crew operated in the Santa Barbara area during the biennium and between June 11, and June 30, 1956, detonated 51,795 pounds of black powder, killing 56 fish.

In all, four regular seismic crews operating in Southern California waters during the biennium detonated 3,215,676 pounds of black powder which killed 1,970 fish.

In addition, a series of experimental seismic shots were made in an effort to find a cheaper and safer substitute for black powder that would do as little damage to fish life. Observations were made of the use of explosives in pier removal near Elwood and in sewer outfall construction at White Point.

GAME MANAGEMENT

A mother takes her ducklings for a rubber-necking tour around Honey Lake, State waterfowl management area.
(Fish and Game Photo by Wm. Anderson)

Game management activities and services during the biennium were keyed to keep pace with the growing demand for hunting opportunities and to maintain game species and habitat in good, healthy condition.

The department has made every attempt to provide a wise use of the resource through research and sound management practices. As a result, game species are maintaining their numbers and in many cases increasing in spite of ever-increasing hunting pressures and record, or near-record, bags taken during the biennium.

To preserve and develop existing wildlife habitat and to provide greater hunting opportunities, the department has requested jurisdiction over 542,903 acres of public lands under the U. S. Coordination Act of 1946. This act provides that public lands owned by the United States may be placed under administrative control of the state which dedicates them for wildlife and recreational uses. Plans of the department call for habitat development and construction of access roads on these lands if funds for such purposes become available.

During the biennium, 40 miles of access roads were constructed, opening many thousands of acres of public lands to hunters.

Among other activities of the branch during the biennium were active participation in the work of the Pacific Flyway Council on waterfowl and close cooperation with Oregon and Nevada on problems relating to the interstate deer herds. The council, made up of representatives of the western states, makes recommendations to the U. S. Fish and Wildlife Service on seasons and bag limits and other waterfowl problems of the flyway.

PITTMAN-ROBERTSON PROGRAM

During the biennium California received $1,146,271 in federal aid apportionments. California's contribution, as required by the Pittman-Robertson Act, was

$382,090, making a total of $1,528,361 for carrying out the federal aid program in California.

These funds are derived from excise taxes on sporting arms and ammunition levied at the manufacturer's level and apportioned to the states under the Pittman-Robertson Act for wildlife restoration purposes.

In California these funds were allotted to 14 projects set up for improvement and management of the resource, either through research or development and management of the game species and game habitat. Five of these projects were in the field of research and involve gathering data necessary to solve the problems arising in the management of the game species. One coordination project provides general administration of Pittman-Robertson activities.

Seven of the projects are devoted exclusively to development of waterfowl areas throughout the State and one is concerned primarily with springs development, quail, chukar and deer guzzler construction and maintenance, and brush manipulation by means of tractor operations, control burning, and chemical plant control. It is the department's largest single Pittman-Robertson project and is state-wide in scope.

DEVELOPMENT PROJECTS

Of the total federal aid moneys received during the biennium, the largest share was spent on development projects (approximately 60 percent). Development projects on waterfowl management areas include land leveling, levee and irrigation system construction, building construction, production of waterfowl food crops and general operation and maintenance of the areas.

The following is a list of waterfowl development projects carried on during the biennium, showing area size and food crop acreages:

Gray Lodge Waterfowl Management Area (6,735 acres). Waterfowl food crops include rice, barley, milo, and millet under cultivation; approximately 5,000 acres in crop producing area.

Imperial Waterfowl Management Area (Finney-Ramer 2,064 acres; Hazard-Fleet, 535; Wister, 5,010 acres). Waterfowl food crops under cultivation include rice, millet, barley, and sesbania; approximately 1,000 acres.

Honey Lake Waterfowl Management Area (4,819 acres). Waterfowl food crops under cultivation are barley, wheat, rye and clover; approximately 950 acres.

Madeline Plains Waterfowl Management Area. The development work accomplished with Pittman-Robertson funds here included construction of well and pump installations.

Los Banos Waterfowl Management Area (3,000 acres). Waterfowl food crops under cultivation include millet and barley; cropland areas approximately 1,100 acres.

Grizzly Island Waterfowl Management Area (8,600 acres). Waterfowl food crop under cultivation was barley; approximately 3,500 acres in crop lands.

Mendota Waterfowl Management Area (8,536 acres). Waterfowl food crops under cultivation include barley and millet; approximately 1,800 acres in cropland area.

Largest P-R Project

Under the game habitat development project, most extensive in the program, a great many activities were undertaken throughout the State. Some of the more noteworthy accomplishments are listed below.

1. Twenty-one new guzzlers were installed and five were enlarged; over 2,600 maintenance checks were made on existing installations, and needed repairs made.

2. A total of 210 springs and wells were located, checked, or developed.

3. Over 5,000 acres in small plots were cleared of brush by burning, chemical spraying, or by mechanical means. By clearing small plots in planned locations, the area which benefits game is many times the area actually cleared.

4. A total of 2,470 acres of cleared or burned areas were seeded.

5. Browse plantings—5,352 individual plants set out for game cover and feeding cover; 3,600 plants received for future plantings.

6. Ten miles of trails and access roads were constructed.

THE GAME HARVEST

Game bags remained at a high level during the biennium, with record bags being reported on some species.

Statistics on the game bag were compiled from hunter questionnaire surveys, count of birds taken on cooperative hunting and waterfowl management areas, and from a tabulation of deer tag returns.

This 1,200-gallon capacity tank, twice the size of a normal quail guzzler, is installed in Kern County in typical chukar country.
(Fish and Game Photo by Harold Harper)

Game Kill 1948-1955

Species	Yearly average indicated bags 1948-1953*	1954*	1955*
Bear	4,300	4,900	4,500
Chukar Partridge (first open season 1954)		2,100	4,000
Doves	2,348,100	2,460,200	2,571,500
Ducks	3,239,700	3,451,500	3,289,000
Geese	385,200	428,200	338,900
Jackrabbits	841,800	1,200,500	1,241,500
Jacksnipes (first open season 1953)	44,200	14,500	19,500
Pigeons	189,900	120,500	135,500
Pheasants (cocks)		554,800	540,200
Pheasants (hens) (first open season 1955)			125,300
Pheasants (total)	536,800	554,800	555,500
Quail	1,515,700	1,483,800	1,295,900
Rabbits (cottontail-brush)	538,300	505,000	457,200
Sage hens		3,400	1,400
Tree squirrels	47,500	40,300	32,300

*As reported by hunters in statewide questionnaire surveys.

The hunter questionnaire survey has been a standard procedure since 1948, with questionnaires being sent to a 2 percent random sample of hunting license buyers.

The information obtained from these questionnaires is considered typical of the entire hunting public, and is projected mathematically to obtain a state-wide figure. This system, however, produces somewhat exaggerated results. Factors leading to the exaggeration remain constant, so that the indicated trends from year to year of the game bags are considered reliable. A change in the questionnaire form prior to the 1954 survey contributed to the recording of a more accurate reported take.

BIG GAME

The deer population recovered from the severe losses of the winter of 1951-52 within two years, as was evidenced by the regular season reported buck kill of 75,602 in 1954, an all-time record for California. In addition a total of 2,326 deer were taken during special seasons that year.

The deer kill of 1954 is all the more impressive when it is remembererd that northeastern California (District 1¾) was closed to the taking of forked-horn bucks during 1954 and 1955 due to action of the State Legislature.

In 1955, the regular season reported buck kill dropped off to 71,126 animals, still the second highest regular season buck kill in this State. In addition, a total of 9,460 deer were bagged during special deer seasons. The total deer bag (both regular and special seasons) in 1955 was 80,586 animals.

Elk

An elk hunt was held in Owens Valley, Inyo County, in 1955. A management plan for this herd of Tule elk was developed in 1952, after considerable discussion with interested local sportsmen, ranchers, and business organizations and groups.

The plan, which has general local support, stipulates that the elk herd will be held at a population of 125-275 animals. Whenever the census shows that the population has exceeded the upper limit, a hunt is held to reduce the herd size to the lesser limit. The elk hunt held in 1955 was for this purpose.

A total of 150 permits was authorized for a December 3-11 season. The checked bag of 144 animals included 36 bulls, 79 cows and 29 unclassified elk.

Special Deer Seasons

Twenty special deer seasons were authorized by the commission to relieve range and agricultural damage, or both, or to harvest surplus animals during the biennium.

A total of 11,793 deer were reported taken. The bag included 2,099 males and 9,408 females and 286 deer designated as "unclassified" in the tabulation because tag returns failed to indicate sex.

The law specifies a public hearing must be held in the area affected before a special hunt can be authorized. The commission's policy has been to authorize a special deer hunt only when local support for such a hunt is demonstrated.

The first special hunt for antlerless deer had been held in the winter of 1949-50 on Catalina Island. In June, 1950, the commission, after discussing the matter with sportsmen, ranchers and others throughout the State, adopted a policy of maintaining deer herds at

20-year Deer Kill Record

Year	Kill	Tag sales
1935	21,995	110,808
1936	25,008	125,855
1937	32,241	136,389
1938	35,045	141,598
1939	43,250	152,924
1940	46,317	153,285
1941	43,493	173,699
1942	25,902	115,121
1943	25,215	147,795
1944	36,940	178,250
1945	38,129	214,552
1945	47,419	282,050
1947	47,178	299,510
1948	47,789	300,405
1949	52,082	309,829
1950	47,128	312,552
1951	64,519	342,900
1952	50,567	359,149
1953	58,992	370,938
1954	75,502	397,555
1955	71,125	410,205

Proper care of this buck during coastal deer season assured good eating for G. E. McCain of Bakersfield. Scene is in East Liebre Mountain Camp, Los Angeles County.

(Fish and Game Photo)

their range carrying capacity by harvesting deer of either sex. There have been 38 special hunts, 20 of them in the last biennium. These helped establish the groundwork for a decision by the commission in May, 1956, to hold the first general antlerless seasons in the State. They were slated for the fall of 1956 in 34 counties.

Widespread Interest Created

These special hunts created such widespread interest among the sportsmen that a total of 85,610 applications were received for the 20,453 hunting permits allotted.

The following is a summary of the various special deer seasons held during the biennium:

Glennville, Tulare and Kern Counties. Two special either-sex deer seasons were held on privately owned lands in the Glennville area primarily to relieve pasture damage caused by a high deer population. In 1954, 200 permits were authorized for the October 28th to November 2d season. A total of 174 deer (42 males and 132 females) was bagged. In 1955, 200 permits were authorized for a November 3d-8th season. A total of 160 deer was reported taken. The breakdown showed 43 males, 116 females, and 1 unclassified.

San Benito, San Benito County. Two special antlerless deer seasons were held on privately owned and public lands to relieve alfalfa and pasture damage by an increasing deer population. In 1954, 330 permits were authorized for a September 18th to October 3d season. A total of 45 males and 128 females, was reported taken. In 1955, 250 permits were issued for a September 24th to October 2d season. A total of 104 deer was reported taken (27 males and 77 females).

Barton's Flat, Fresno and Tulare Counties. Two special either-sex deer seasons were held on the Barton's Flat area to harvest surplus deer from a population which summers partially in Kings Canyon and Sequoia National Parks and is unavailable during the regular hunting season.

The repeated hunts, of which there have been four, may serve to demonstrate the effects of the continued harvest of deer of both sexes.

The 1954 hunt (with 400 permittees shooting) was held during four periods in a November 17th to November 29th season. The reported bag was made up of 82 males and 87 females. Another 400 permits were authorized in 1955 for a November 18th-30th season. The reported bag was 74 males and 89 females. During the four-year period, the bag for both regular and special seasons has increased from an average of about 200 bucks only to an average of about 500 deer per year.

Camp Pendleton, San Diego County. Two special hunts for antlered and antlerless deer were held on the Camp Joseph Pendleton Marine Base to harvest surplus animals. Hunting was limited to service personnel. In 1954, 260 antlerless and 45 antlered permits were authorized for use during 13 week-end hunting periods between August 7, 1954, to January 23, 1955.

The Department of Fish and Game disease laboratory personnel examined bagged deer for evidence of disease, parasitism, general condition, and reproductive rate during every second hunting period. The commission authorized the take of an additional 40 deer during March and April of 1955 in order to fill out the scientific information. A total of 167 deer was taken, of which 38 were males and 129 were females.

In 1955, 220 antlerless and 55 antlered permits were authorized for use during an October 1, 1955, to March 18, 1956, season. A total of 31 males and 133 females was taken. The disease laboratory examined bagged deer once a month to complete the scientific study.

San Joaquin River Unit, Fresno and Madera Counties. An either-sex deer hunt was authorized in 1954 for 600 permits during an October 27-31 season to lighten range damage. A total of 360 animals was reported taken, including 83 males and 277 females.

During 1955, 500 permits were authorized for a second either-sex deer hunt during a November 1st-6th season confined to the portion of the unit in Fresno County. The reported bag of 198 deer included 43 males and 155 females.

Sierra Foothills, Zone 1, Nevada, Placer and Yuba Counties. During 1954 a special either-sex deer hunt was authorized in portions of Nevada, Placer and

Center photo shows bitterbrush leader growth, choice forage for deer. Flanking photos show damage done by deer to forage species. At left is a "hedged" bitterbrush which normally grows like bush in center but which has been misshapen by hungry deer. At right is a "high line" on a juniper, so-called because it is browsed to the maximum height reachable by deer.

(Fish and Game Photos)

Yuba Counties, for 1,000 permittees during an October 11th-24th season. A total of 318 deer, 66 males and 229 females and 23 unclassified, was reported taken. The hunt was held primarily to relieve agricultural damage in the Sierra foothill area.

Sierra Foothills, Zone 11, El Dorado, Placer, Sacramento and Amador Counties. A special either-sex deer hunt was held in 1954 primarily to relieve agricultural damage in this foothill ranch area. One thousand permits were authorized for an October 4th-17th season. A total of 373 deer was reported taken, including 78 males, 280 females and 15 unclassified.

Capay, Yolo County. In 1954, a special antlerless deer season was held in the Capay Valley area primarily to relieve agricultural damage. One thousand permits were authorized for an October 25th-November 7th season. A total of 417 deer was reported taken. The bag included 79 males, 326 females and 12 unclassified deer.

Devil's Garden, Modoc County. A third special antlerless deer hunt was held on the Devil's Garden interstate deer herd range in 1955 to harvest surplus deer and lighten range damage. Other special hunts were held in 1950 and 1951. A quota of 3,500 permits was authorized for a December 10th-18th season. A total of 2,008 deer was reported taken, including 263 males, 1,732 females, and 13 unclassified animals.

Lassen-Washoe Unit, Plumas, Sierra and Lassen Counties. A second special antlerless deer hunt was held on the interstate herd unit in 1955 to harvest surplus animals and decrease range damage. The first special season was held in 1951. A quota of 3,000 permits was authorized for a December 10th-18th season. Hunters reported a take of 1,858 deer, including 246 males and 1,612 females.

Tehama County. A special antlerless deer season was held in eastern and southwestern Tehama County in 1955. Five thousand permits were authorized for a November 1st-6th hunting period. The hunt was held primarily to allow harvest of surplus deer and lighten the pressure on the range. A total of 2,715 animals was bagged, including 444 males, 2,247 females, and 24 unclassified deer.

Napa County. A special antlerless deer season was held September 24th to October 3d in 1955 in the central portion of Napa County primarily to relieve agricultural damage. One thousand permits were authorized. A total bag of 452 animals was reported. The bag included 34 males, 307 females and 111 unclassified deer.

Mineral King National Wildlife Refuge, Tulare County. A first special either-sex deer season was held in this national wildlife refuge in 1950 to help cut down a heavy deer population and relieve a serious range depletion condition. It became necessary to authorize a second special season for this purpose in 1955. Five hundred permits were authorized for a September 29th to October 11th season. A total bag of 383 deer was reported, including 222 males and 161 females. During the second hunt it was found that fawns born in 1950 made up the third largest group of deer in the 1955 bag. Fawns born in 1951 made up the largest group and those born in 1954 the second largest.

Carson River, Alpine County. A special antlerless deer season was held in this area in 1955 to harvest surplus deer and lighten range pressure during November 5th-13th. Five hundred permits were authorized. A total reported bag of 367 deer included 42 males and 325 females.

West Walker, Mono County. A special antlerless deer season, with a quota of 500 permits for a November 5th-13th hunting period, was authorized in 1955 in order to remove surplus deer and decrease range damage. A total of 380 deer was taken, consisting of 31 males, 435 females and 6 unclassified deer.

Owens Valley, Inyo and Mono Counties. A special antlerless deer hunt was held in the Owens Valley area in 1955 during a November 5th-13th season with a quota of 600 permits. The hunt was held to harvest surplus deer and lighten range damage. A total of 508 deer (42 males, 455 females and 11 unclassified animals) was bagged.

INVESTIGATIONS

Several former Pittman-Robertson projects were combined during the biennium into one big game investigations project which is comprised of related segments of various phases of big game activities.

Public shooting grounds on the department's Imperial Waterfowl Management Area in Imperial Valley yielded this bag of ducks to Glenn Leslie of Burbank.
(Fish and Game Photo)

One segment consists of big game management projects throughout the State and the other of big game investigations. Both are coordinated regionally and state-wide.

MANAGEMENT

Field personnel of a former big game studies project were transferred to the various regions to work with other regional personnel in obtaining information needed for proper management of deer and other big game animals. The deer herd studies which were in progress under the former project have been completed.

Mimeographed final reports have been issued on the Inyo-Sierra deer herds, three Siskiyou County deer herds, an inner coast range deer study and a south coast range deer study. Four final reports are under preparation on harvest and yield of the Barton's Flat deer, the San Joaquin deer herds, deer of the Kern River drainage and two Yolla Bolla unit deer herds.

One field man in Region I has been assigned to continue the antelope investigation. This investigation aims at discovering and reducing the factors which have held down antelope productivity in this State. Findings of the former project have been published in a mimeographed report entitled "Northeastern California Antelope Studies." So far the results of the investigation indicate that neither predation nor disease are important factors in the low survival of antelope kids. Indications at this time are that some range component on California's submarginal antelope range is in short supply. A survey of antelope stocking sites was made.

No formal investigation of the state-wide status of bighorn sheep has been made, but information on this big game species has been gathered whenever the opportunity presented itself. A survey of possible planting sites in the Trinity Alps indicated that successful introduction of bighorn sheep into this area would be extremely doubtful due to a lack of suitable wintering areas.

INVESTIGATIONS

Equally important with the management phase of the project is the range investigations phase. It consists of probing the effects of brush removal on game ranges in California and studying the problem of game range restoration.

The brush removal investigation is being conducted by the University of California under a service agreement with the department. The work is now focused on effects of brush management on deer of the San Joaquin (Madera County near the north fork of the San Joaquin River) migratory deer winter range.

Intensive studies are in progress on the effects of different types of brush treatments on forage production, deer numbers and movements, and over-all range condition.

Information on deer movements already obtained from observations of, and returns from, 134 belled deer have changed former concepts about migration routes and summer ranges of this deer herd.

Game Range Restoration. This part of the project is being continued under a service agreement with the California Forest and Range Experiment Station. Its purpose is to develop means of increasing desirable deer browse on depleted ranges.

During the period, the investigation has progressed from small plot trials of bitterbrush seeding to experimental field plantings. Bitterbrush has been grown successfully with proper soil preparation and planting, but search for less expensive and more practical seeding methods is still in progress. The scope of the

Trapping ducks for banding on Los Banos Waterfowl Management Area.
(Fish and Game Photo by Wendell Miller)

Public Shooting

Acreages Open

Year	Acreages open		Total
	State	Federal	
1954	25,050	4,280	29,330
1955	29,050	4,200	33,250

Hunting Results

Year	Number hunters	Birds taken	Average per hunter
1954	32,601	81,054	2.5
1955	34,819	99,244	2.9

investigation has been broadened to include other desirable deer browses adapted for planting at various elevational and precipitational levels.

WATERFOWL

Ducks have consistently produced the greatest bag of any of the game targets. During 1954 and 1955 the population of waterfowl wintering in California remained high and was reflected in a good harvest each year.

The number of geese bagged remained high, but hunting was best during 1954. During 1955 many hunting areas were inundated, and were not accessible to hunters. Both ducks and geese used these isolated areas as natural refuges. This condition was especially prevalent in the Sacramento Valley, and here hunter success fell below the previous year.

MANAGEMENT AREAS

There are 19 waterfowl management areas totaling 202,017 acres, located throughout the State. Of these, 10 areas totaling 52,027 acres are state-owned or leased and nine areas, totaling 149,130 acres, are national wildlife refuges. Of the nine federal areas, four are managed for public hunting by the department under commission regulations.

All of these areas provide feed, resting and nesting for upland game as well as for waterfowl. During the period of this report waterfowl depredations have been at an all-time low, evidence that these areas play a major part in the control of crop damage.

During the biennium the Wildlife Conservation Board purchased additional land (4,194 acres) for the expansion of Gray Lodge and also acquired the Mendota Waterfowl Management area of 8,536 acres. Another 5,523 acres in the Wister area was added to state property in Imperial Valley.

Waterfowl public shooting was conducted on all state areas and on those federal areas purchased with Lea Act funds. A fee of $2 per day was charged to all hunters using the area in order to defray the expense of operating public shooting.

Pheasant hunting was also conducted on waterfowl areas. During the 1955 season these areas issued permits to 9,302 hunters who bagged 5,351 birds, for an average of 0.57 birds per hunter.

INVESTIGATIONS

The waterfowl section gathers information used by the Fish and Game Commission, the Pacific Flyway Council and the U. S. Fish and Wildlife Service in formulating policies and establishing regulations. There are five main activities of the section which are financed partially by Federal Pittman-Robertson funds. They are listed below.

Winter Inventory. Inventories of waterfowl are made annually to determine the numbers of waterfowl wintering in California, the most important wintering area on the Pacific Flyway. Populations are determined through aerial photographs of concentrations and aerial estimates that are made of scattered flocks. Five airplanes and a U. S. Coast Guard helicopter are used to conduct the inventory. Results are indicative of the numbers of birds that will return to

Harry Stauffer (left) of Montrose and James Jones of La Canada smile over limits taken on the department's co-op pheasant hunting area near Lancaster, Los Angeles County.
(Fish and Game Photo)

the breeding grounds. In January, 1956, over 5,000,000 ducks were tallied, the highest number recorded in recent years.

Breeding Grounds Survey. The major waterfowl breeding grounds within the State are surveyed each spring to determine the local production of ducks and geese. Mallards and Canada geese are the important species breeding in California. The U. S. Fish and Wildlife Service uses this information, along with that obtained from surveys made in other states, Canada and Alaska, to determine the hunting regulations each year.

In 1954 the survey revealed a total of 339,750 young and old ducks and 21,070 geese. These figures slipped to 289,120 ducks and 14,810 geese in 1955.

September Inventory. Each year during mid-September an aerial inventory is made of the central valley. The number of birds and areas where they are concentrated is determined during the time of crop depredations. In 1954 the inventory showed 541,000 ducks and in 1955 it showed 724,000.

Waterfowl Kill. Information is gathered annually concerning the hunting season kill by mail questionnaire, by hunter checks on public shooting areas and by kill records from representative duck clubs. Total waterfowl kill, areas where the kill is made, and the species predominating in the kill is then determined. In 1954 hunters shot 3,461,600 ducks and in 1955 they bagged 3,312,700.

Banding Operations. The waterfowl banding program is conducted on a state-wide basis from Tulelake to Imperial Valley. Information obtained from this study is used to determine mortality rates, population turnover, and the migration patterns of the various species. During the past two years 67,496 ducks, 12,038 geese and 6,940 coots were banded. As an aid to the migration studies some of the geese were color-marked.

UPLAND GAME

Introduction of a game bird new to California hunters, the chukar partridge, liberalization of pheasant hunting regulations, a change in game bird club regulations, and near-record bags of nearly all upland game species resulted in two banner years for hunters.

PHEASANTS

During 1955, pheasant hunting regulations were liberalized, extending the season from 10 to 16 days, and allowing one hen in the seasonal bag limit.

This liberalization in pheasant hunting regulations resulted in increasing the total bag of pheasants by 20 to 25 percent.

Indications during the spring of 1955 led to the conclusion that the regulated take of hens left an adequate breeding stock and predictions for another good year in 1956 were in prospect.

Hunter Merv McClure brings down a pheasant in the Natomas district of Sacramento County.
(Fish and Game Photo)

During the biennium the department's game farms released 92,584 ringnecked pheasants. These birds were generally held to maturity and released just prior to or during the pheasant season, in accordance with policy. Working in cooperation with the department's game farms were sportsmen's pens which reared and released 62,303 ringnecked pheasants throughout the State. In addition 4,948 chukar partridges were reared and liberated by the department.

Results of studies of major pheasant management problems led to legislative changes in the licensed game bird club program in 1955.

Changes Enacted

Changes included zoning of the State into natural pheasant habitat areas (Zone A) and nonhabitat areas (Zone B). Clubs operating in Zone A were under much the same restrictions as in effect formerly, whereas clubs operating in Zone B had the benefit of lesser restrictions.

Fees for "commercial" clubs (open to the public on a daily fee basis) were increased from $50 to $100 annually. Fees on "private" (open to members only) clubs were hiked from $50 to $100 for those over 500 acres and from $25 to $75 for those under 500 acres.

There was also an increase in the price of department meat seals for each bird from 3 cents to 5 cents. A department inspection fee of 5 cents a bird was added during the biennium.

The 75-day season in existence throughout the State remained the same for Zone A, but a six-month season (September 1st to February 28th) was set for Zone B.

Percentage of liberated birds allowed for each club in Zone A was reduced from 70 percent to 65 percent,

State Trapper Ed Sayles takes chukor from trap and places it in carrying box for transplanting to new areas.
(Fish and Game Photo)

with no birds being released prior to August 1st in Zone A for the current season. Clubs in Zone B were permitted to take 100 percent of the birds liberated.

For the past two years there has been a steady increase in the use of the department's cooperative pheasant hunting areas.

In 1954 the department operated 22 cooperative areas, with a total of 189,885 acres open to hunting, accommodating 92,237 hunters, who by actual count bagged 34,480 birds, for an average of 0.37 birds per hunter.

Community Areas

During 1955, 18 areas were operated with 161,417 acres open to hunting; 97,158 hunters used the areas, taking 34,990 birds, for an average of 0.36 birds per hunter.

There has been a steady increase over the past two years in the number and acreage of so-called community areas. These are operated by members of local communities on land donated by local landowners. A daily fee or seasonal fee is charged. The net profit is then turned over to community service projects.

Indications at the end of the biennium were that expansion of licensed game bird clubs and community areas would materially reduce the prime pheasant hunting acreage in the co-op areas for the 1956 hunting season.

Chukars Planted

Location	No. of birds	
	1954	1955
Poso Creek, Kern County	149	46
Caliente, Kern County		247
Lower Kern River Canyon, Kern County	272	61
Panoche Hills, Fresno County	98	114
Griswold Hills, San Benito Co.	197	
Mercy Hot Springs, Merced Co.		185
Total	716	653

QUAIL

Weather conditions were near normal in 1954 and 1955, except for the record precipitation in December of 1955. This was reflected in a quail take slightly above normal in 1954 and slightly below normal in 1955. The lower take in 1955 probably was a result of bad weather keeping hunters indoors, and scattering the birds, rather than a decrease in quail populations.

Wherever habitat development for quail has been carried on, consisting mostly of guzzler construction and spring development, they have responded well and good populations are found in all these areas.

Twenty-one new guzzlers were installed throughout the State and another six enlarged. Routine maintenance checks were made on another 2,604 guzzlers.

The department located and developed 188 new springs during the period.

Doves take a morning nip at a quail guzzler.
(Fish and Game Photo by Wally McGregor)

The burglar stealing these eggs during a nesting study of Sacramento Valley ducks is a spotted skunk, one of a number of predators who annually take a large toll of eggs.

(Fish and Game Photo by Wm. Anderson)

CHUKARS

Chukar partridges, introduced in California in 1928, became well enough established in some of the arid regions of the State at the beginning of the biennium to permit the first open season in the fall of 1954.

Results of hunter questionnaires in 1954 and 1955 revealed approximately 2,100 of the birds were taken in the first season and almost double that figure (4,000) in 1955. The birds provide excellent sport to those hunters hardy enough to pursue them.

The rearing of chukars on game farms has been discontinued, as it is far more economical to trap the necessary birds for brood stock from wild populations. During the period of this report, 1,369 chukars were trapped in Inyo County and transplanted in suitable habitat in Kern, Fresno and San Benito Counties.

A chukar investigation was completed in 1956. This study was undertaken to determine the areas in which this recently introduced game species had become established, to obtain information for management, and to learn whether a hunting season was advisable.

There have been two brief hunting seasons to date and the 1956 season was set to be the same length as the quail season in the same areas.

In cooperation with regional management personnel, 1,369 chukars were trapped on the Naval Ordnance Testing Station land in the Coso and Argus Mountains of Inyo County and transplanted into apparent chukar habitat where no chukars were known to exist. Reproduction has been successful at or near all of these areas.

DOVES

Doves continued to be a highly rated hunter target during the biennium, with both 1954 and 1955 producing near record bags. The second in importance among all game birds, doves were topped only by the combined take of all species of ducks.

In spite of the seemingly heavy pressure, band returns provide a solid indication that hunters are not the dove's worst enemy. Bands indicate that hunters take only a token harvest. Department records show a return by hunters of only 3 percent of the bands placed on birds, compared to a state-wide average of 18 to 20 percent for waterfowl tags.

The department undertook a study of doves in 1955 to determine the extent of California's dove range, production and survival of young, migration and hunters' bag. This data is important in formulating management practices on any species.

In 1955 over 1,600 mourning dove nests were under observation by project personnel. In 1956 a total of 1,030 mourning dove nests was under observation as the biennium closed.

Dove wing examinations during 1954 and 1955 hunting seasons showed that, on a state-wide basis, 64 percent of the 3,506 wings checked in 1954 were from young birds of the year and 62 percent of the 3,858 wings checked in 1955 were from young birds of the year.

This indicated the State's dove population to be in a very healthy condition.

PIGEONS

The pigeon take was below normal in 1954 and 1955. This was due to the distribution of the birds during the hunting season, rather than any decrease in the pigeon populations. In 1955 many birds from northern sections of the flyway did not move into the State until after the hunting seasons were over.

Information obtained by trapping indicated that there was better than normal reproduction in 1955. Large populations of pigeons were present in agricultural areas from January through March of 1956, and pigeon depredation complaints increased during this period.

A band-tailed pigeon investigation was completed in 1955. It was undertaken to determine the status of this game species by obtaining data on reproduction, range, migration, and hunters' bag, upon which the recommendations for management could be based.

A total of 26 nests was under observation. It was found that the nesting season extended from early February to the middle of October. It was also determined that in at least one case three nestings in the same nest, by color-marked adults, were successful out of four attempts in one year.

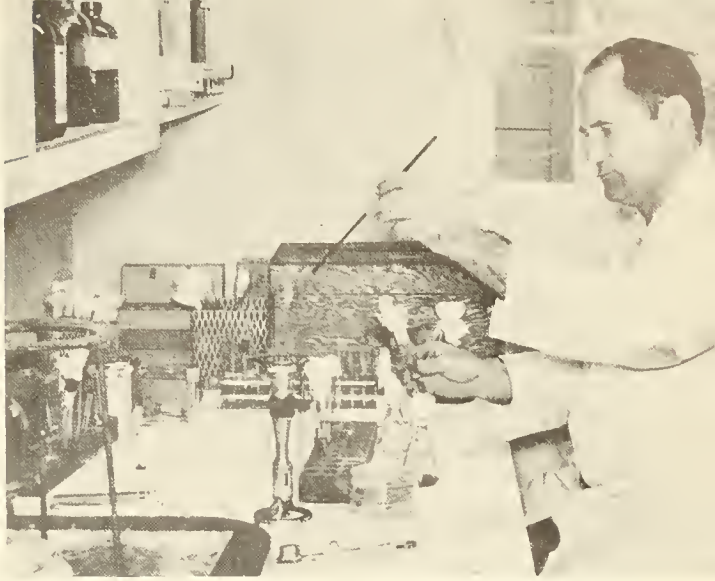
Over 2,000 band-tailed pigeons were banded by project personnel in order to determine the extent and routes of migration. Pigeons banded in California were taken from British Columbia to the Mexican border.

Of the 4,660 pigeons banded in the west within the last 20 years, 313 bands have been returned, 139 of which were from birds banded in California. The findings of the study have been published in part.

FUR RESOURCES

During the biennium 1,316 licensed trappers took 199,990 pelts with an estimated value of $244,768 at the raw fur price.

The 1955-56 trapping season showed a decrease of 28 percent in reported catch. This decrease was attributable to the heaviest rainfall in the history of the State occurring during the height of the muskrat trapping in the Sacramento and San Joaquin Valleys. The buyer demand has remained for the short-haired species, muskrat, mink, otter and beaver.



Oscar Brunetti, Game Management Lab Chief, conducts an investigation. (Fish and Game Photo)

PREDATOR CONTROL

During the biennium, 3,171 coyotes, 1,592 bobcats and 7,849 lesser predators (skunks, coons, possums, etc.) for a total of 12,612 were taken by department predator control men.

The department's policy is to trap predators, whenever such trapping will benefit management of game. As a consequence particular effort is exerted on predator control on deer fawning areas, antelope kidding grounds, waterfowl and upland game nesting areas and areas where public access to hunting is allowed.

Although there is no direct evidence to support the contention, the excellent hatch in upland game in the Marysville area this year can be attributed in some measure to the late 1955 floods which wiped out countless thousands of small predators which might have preyed on eggs or chicks.

MOUNTAIN LION CONTROL

During the biennium 344 mountain lions were bountied, 75 by state lion hunters, 268 by private individuals. Of this total 183 were taken in 1954 and 160 in 1955. The bounty is $50 per male lion and $60 per female. There were three department lion hunters during the biennium.

FISH AND GAME LABORATORY

During the biennium, investigations continued on wildlife diseases, wildlife food habits and nutritional requirements so that epidemics might be anticipated and effective control measures applied, and knowledge of food habits and nutrition might be effectively used as management tools.

Botulism

There were only a few scattered and minor outbreaks of botulism during the biennium, with losses of insignificant proportions.

Laboratory and field studies on the disease indicated the importance of aquatic insect life and the role of fly larvae in the epidemiology of the disease. It was found that a single fly maggot could contain enough botulinus toxin to cause illness in a pheasant, and three to cause death quickly.

That ducks do consume maggots has been shown by examination of the gizzard contents of ducks sick or dead from the disease. A high percentage of shore birds found infected have fly larvae in their gizzards. This indicates that the carcasses left in a botulism area are a factor in the continuation and spread of the disease. One of the vital procedures followed in botulism control is the removal of these carcasses from the area. This is particularly important in outbreaks among game farm pheasants.

Fowl Cholera

There were three minor outbreaks of fowl cholera during the biennium. In the delta area, 406 swans by actual count were victims of the disease. Just outside Gray Lodge Refuge about 1,000 birds, primarily coot, succumbed. On the Colusa Federal Wildlife Refuge another 2,000 birds, of which 1,800 were coot and 200 were widgeon, pintail and mallard, were lost.

Control measures consisted principally of removal of carcasses. It was found that infected gulls, swans and geese were instrumental in spreading the disease to other areas because of natural resistance which enabled them to survive long enough to fly considerable distances.

Department personnel could not have created a better clinical laboratory test of this than one they observed in the field. As they watched a flight of snow geese, one set its wings and glided to earth at Honey Lake, Lassen County. The bird was penned and died in about four hours. Game laboratory diagnosis tabbed the cause of death as pasteurellosis—fowl cholera. It was the first case ever found at Honey Lake, an area not considered endemic to fowl cholera, indicating the bird came from an infected area, possibly from the delta which experienced an outbreak at that time.

Aspergillosis

The largest outbreak of aspergillosis, a disease involving pneumonia-like symptoms, was discovered near Woodland where 400 ducks were victims.

The department laboratory traced the outbreak to a rice hull dump where the ducks had fed on moldy rice remaining in hulls. The dump owner agreed to burn his hulls continuously as he dumped them. After the burning there was no repetition of the disease.

Trichomoniasis

During the biennium outbreaks of trichomoniasis in doves were investigated in the vicinity of San Diego, centered in the metropolitan area. Incidence of infection was as high as 10 percent of the population. The infection appears in the spring and dies out by fall. Prophylactic medication with the drug enheptin was applied in the late spring of 1956 in dove concentration areas.

Economic Poisons

During the biennium investigations were begun on the problems of economic poisons on wildlife. These studies were mainly field investigations on incidence of losses. Contact was made with agencies employing poisons and sprays, and attempts were made to correlate losses with the use of these agricultural sprays and poisons. With the increased use of these insecticides and poisons, problems continue to arise in regard to their effects on wildlife.

Nutritional Studies

During the biennium comparisons were made of the relative effects of net digestible protein and digestible carbohydrates and fats and their importance in deer survival. An expanding program is being undertaken to study the effects of environment on deer. These studies include the effects of weather and climate on the deer and their movements, as well as the effects of these and other stresses on the well-being of the herds, and the interrelation of all of these factors, including nutrition, on the problem of deer losses during the winter.

Food Habits of Wildlife

Continuing studies were made of the food habits of game and predators. This knowledge of the food preferences of the game species becomes a valuable management tool in assessing range conditions.

In addition, food habits determinations were made for the game departments of several western states. This service has been paid for by these states on a cost basis.

WILDLIFE PROTECTION

A game warden looks over a portion of the terrain he must patrol.

(Fish and Game Photo)

Continuing efforts of the department to provide optimum hunting and fishing success for California's sportsmen have directly affected work performed by members of the Wildlife Protection Branch. Steadily rising prices for goods and services made it mandatory that the department critically examine its functions and strive for greater efficiency of operation in those areas where increased economy could be realized.

Harvesting surpluses of wildlife without damaging breeding stocks is the fundamental concept of wise management upon which the entire program of the department is based. Basic to this concept is the necessity to safeguard these breeding stocks. To this end wardens fulfilled their primary function of protecting fish and game from being taken during closed seasons, in excess of prescribed bag limits or by means which afford little or no chance for the species sought to escape.

Despite a steady growth in the number of California residents, with a proportionate increase in hunting and fishing license buyers, there was no commensurate addition of badly needed wardens.

In July, 1954, the department, cognizant of the need for a basis upon which to judge the effectiveness of the Wildlife Protection Branch, as well as to determine current and future staffing requirements, requested that the Management Analysis Section of the Department of Finance conduct an administrative survey of the branch. The survey was completed in late November, 1954, and a report was transmitted to the Division of Budgets and Accounts, Department of Finance.

Arrests

Type of violation	Number arrests	
	1954-55	1955-56
Deer	525	722
Waterfowl	379	382
Dove and pigeon	120	178
Upland game	481	593
Inland fish	1,452	1,876
Ocean shellfish	897	888
Commercial fish	296	183
Loaded gun in car	1,321	1,354
Co-op trespasa	273	234
Angling, no license	2,153	2,053
Hunting, no license	178	243
Miscellaneous	590	711
Totals	8,776	9,427

Fines and Sentences

	1954-55	1955-56
Fines	$274,803.88	$299,792.22
Jail terms (days)	8,058	3,052

Recommendations

Certain key recommendations were included in the report which suggested that:

"1. Positions of Fish and Game Warden be budgeted on the basis of one such position for each 7,500 angling and hunting licenses sold, this ratio to be exclusive of supervision.

"2. Positions of Patrol Captain be budgeted on the basis of one such position for each nine warden positions.

"3. The use of warden personnel to staff certain types of nonenforcement activities be critically reviewed by the Department of Fish and Game.

"4. A training program be established for wardens, both at the time of entering the service and on a refresher basis.

"5. The Department of Fish and Game develop and install a method of time and activity reporting which will reflect the time devoted to the major phases of the enforcement program."

In accordance with these recommendations, the department asked the 1955 Legislature for an additional 75 wardens and 10 patrol captains. Operating capital for the positions would have derived from the State's share of pari-mutual horse racing money. While agreeing that an increase in personnel was justified, the Legislature considered it unwise to commit money from the horse racing fund to other than capital outlay items, therefore turned down the request.

Meanwhile, the steady growth of California's hunting and fishing public had resulted in constantly greater demands on the wardens' time. By 1955 each warden was committed to the recreational pursuits of 10,392 license buyers.

Wardens Added

A request was made in the 1956-57 Fiscal Year budget for 25 fish and game wardens and five patrol captains. Recognizing the need for additional personnel, the Legislature authorized an increment of 30 wardens and six captains. Plans were made for the new personnel to join the department in the 1956-57 Fiscal Year, and a wardens' training program was undertaken.

Departmental in-service training began in March, 1955, at the wildlife protection supervisor level. By the close of the biennium training had been given through the warden level, and training classes, comprised of personnel from the various branches, had been inaugurated. Plans were formulated for the training of new wardens and captans authorized in the 1956-57 Budget.

Consideration was given to a method of time reporting which would reflect the amount of time spent by wardens in carrying out various components of their jobs. It is anticipated that the labor distribution system drawn up will be put into use early in 1957.

ENFORCEMENT ACTIVITIES

Arrests for violations of fish and game laws increased over those made during the previous biennium by 15 percent. The tendency of the public to travel greater distances in search of hunting and fishing recreation, the opening of formerly inaccessible areas through construction of logging roads and unimproved thoroughfares and the increased use of rugged vehicles capable of penetrating into remote places all had their impact on the arrest record.

Some of the persons apprehended had violated fish and game laws apparently only because they had traveled a long way from home and wanted to return with amounts of fish or game in keeping with the effort they had expended in reaching their chosen hunting or fishing area. Others found themselves in almost virgin hunting and fishing areas where competition was light and populations of fish or game heavy. They succumbed to temptation.

Since it is true that fish and game law violations are committed by a small minority of the hunting and angling public, the number of hunters and fishermen afield during the biennium is evidenced by the arrest figures: 8,775 in the 1954-55 Fiscal Year, 9,427 in 1955-56.

California courts assessed an average individual fine of $31.57 during the 1954-56 biennium. Total fines collected during the two-year period of this report amounted to $574,596.10, a decline of 2.4 percent from fines of the previous biennium. The number of cases

dismissed by the courts, or in which the defendant was found not guilty after a trial, amounted to 172—only .94 of 1 percent.

LOADED GUNS TOP OFFENSES

A table in this section lists fish and game offenses by type during the biennium. Although arrests for angling without a license were the largest single type of offense, as usual, it is noteworthy that loaded guns in motor vehicles accounted for the appearance of 2,675 persons in court.

Incredible as it may seem, an average of more than three persons each day during the two-year period deliberately risked their lives and the lives of others for the doubtful expediency of convenience or haste.

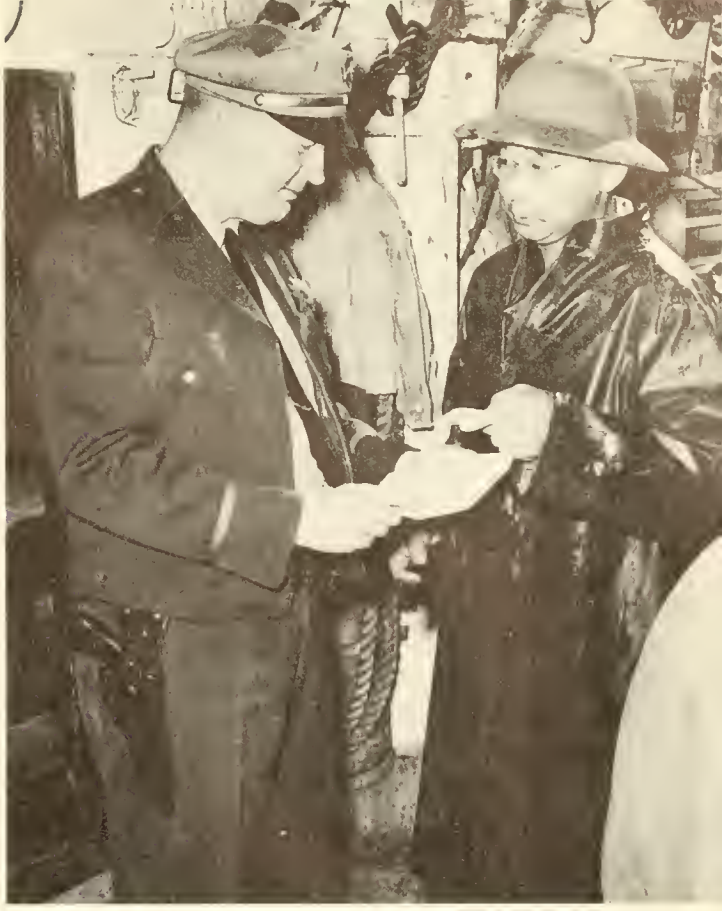
Sales by public auction of hunting and fishing equipment ordered forfeited by the courts as a result of conviction of fish and game violations, as well as revenues derived from the sale of confiscated fish, totaled $39,257.71. Of this amount, $20,623.15 was received from the sale of fish and lobsters taken illegally, while an additional $2,612 was deposited in the Fish and Game Preservation Fund as the result of the sale of nets seized in Southern California waters and later awarded to the Department of Fish and Game by superior court action.

Neither arrest records nor statistics of fines, jail sentences and other penalties give an adequate view of the work of California's wardens in the law enforcement phase of their activities. Program cost figures developed in 1955 showed that wardens devote approximately 70 percent of their total work load to law encorcement. The Department of Finance showed that wardens in 1954 worked an average day in excess of 12 hours, without compensation for any time given in excess of the required eight hours. There has been no change in the wardens' activities which would account for a reduction in the number of uncompensated hours put in since that time. On horseback, in autos, by boat and airplane, wardens covered hundreds of thousands of miles, many of them in remote and uninhabited areas, in making their rounds of California's fish and game areas. Much of the time the warden was necessarily alone, performing his job creditably under often difficult conditions.

FISH PATROL

Significant changes occurred in the habits of California's fishermen during the biennium, and peremptory attention was focused on ultimate development of the State's water resources. New fisheries, lengthening of the seasons and enlargement of areas in which anglers could successfully pursue their sport, gained rapidly in popularity.

Critical water shortages in Southern California, coupled with that area's huge increase in hunting and fishing license holders, resulted in changed patrol patterns by both land and marine wardens.



Marine warden in action in Southern California.
(Fish and Game Photo)

As a number of reservoirs and streams dropped to such low water levels that fishing activities were either curtailed or halted, land patrol effort was shifted to newly developed reservoirs and more stable existing impoundments where new angling pressures built up.

MARINE ACTIVITIES INCREASE

Marine patrol acquired additional burdens as many Southern Californians turned from the dwindling inland waters to the ocean for their fishing recreation and the increasing dollar value of some scarce commercial fish species spurred the catch efforts of the commercial fishing fleet. Large ocean areas off the south coast, where the use of nets is either restricted or banned, required constant attention by patrol craft.

Market conditions in the tuna industry made the landing of undersize tuna attractive to boat and cannery operators, but heavy patrol was maintained and over 200,000 pounds of undersize tuna were seized and given to charitable and public institutions during the biennium.

Many Southern Californians who turned to ocean sport fishing were new residents from states where ocean angling is not available or where an ocean angling license is not required. This unfamiliarity with California law by newly arrived citizens caused marine wardens to spend a large amount of time in the enforcement of angling license laws. In Southern Cali-

fornia, 1,957 convictions were obtained for angling license violations alone.

LOGGING SURVEY

In order to rehabilitate potentially good spawning streams, the value of which was destroyed through stream obstructions, debris accumulations and other poor logging practices, wardens in the northern part of the State assisted materially during the biennium in the survey of all streams in Regions I and III to determine the effect of logging on fish habitats. Special periodic surveys of the Klamath River were made to check on the operation of log dumps. Bark traps were inspected and log rafts watched for possible effects on fishlife.

Section 482.5 of the Fish and Game Code provides that "No person shall cause or permit to exist any log jam or debris accumulation * * * in any stream * * * in Del Norte, Siskiyou, Trinity, Humboldt, Mendocino, Sonoma, and Marin Counties, which will prevent the passing of fish up and down stream or which is deleterious to fish * * *." In certain critical situations arrests were made for violations of 482.5 and successful prosecution followed.

To aid in the maintenance of present good spawning streams and in the restoration of others which had become impassable to migrating steelhead and salmon because of man-made barriers, wardens conferred with timber operators in an effort to reconcile the needs of spawning fish with the demand for more lumber to meet requirements throughout the mushrooming State. While much remains to be done, progress was made in safeguarding streams vital to the future of steelhead and salmon.

The Striped Bass Problem

In the years following the end of World War II, fishing pressure for striped bass in the Sacramento-San Joaquin Delta region has more than doubled in intensity. In the same period, the striped bass population has been on a slow and steady downward trend. To safeguard this important fishery, the Fish and Game Commission in February, 1956, raised the minimum legal length of striped bass from 12 to 16 inches.

Wardens in the delta area intensified their patrol of rivers and sloughs to insure compliance with the length requirement. At the same time, inspections of fish markets and restaurants were stepped up to discourage the illegal sale of stripers, and netting operations were closely watched to prevent the retention of this fish which may not be taken commercially.

During the biennium a game fish long overlooked by anglers gained rapidly in popularity. Shad, present in the State since 1871, at last began to attract interest by a large number of fishermen. One favorite method of taking shad is by means of dip nets during night hours. Since shad is the only species of game fish which may be so taken, wardens directed their attention to adequate patrol of this expanding sport, in order to protect other species of fish present during shad runs.

Pollution Laws Enforced

Increasing industrialization of the State resulted in expanding water pollution problems. In the San Francisco and Los Angeles areas particularly, pollution problems are chronic. One warden in the former city and two in the latter are assigned primarily to enforcement of antipollution laws. During the biennium they remained constantly busy in the investigation of complaints, attendance at conferences and regional water pollution control board meetings, and prosecution in court of wilful violations of laws designed to maintain the purity of state waters.

Protection of salmon, the most important sport fish taken north of Monterey, accounted for heavy patrol effort. In 1955 the Fish and Game Commission changed sport salmon regulations so that it was no longer permissible for ocean anglers to retain one salmon under the minimum length of 22 inches. Wardens concerned themselves with inspections on sport fishing boats to insure that the legal length was observed.

The mounting popularity of salmon fishing both in ocean waters and in the Sacramento River system required wardens to maintain constant vigilance over spawning beds during the autumn and winter months. Many hours on foot, by car or boat, or aloft in the department's aircraft were expended to insure that salmon would not be molested during the critical period.

GAME PATROL

Changes and additions to game seasons did not alter the wardens' work patterns during the biennium as noticeably as did conversions in fishing habits. However, the opening of seasons on some previously unhunted species and special hunts to reduce deer and elk herds in certain areas affected the over-all work load of the Wildlife Protection Branch.

Checking a hunter's bag is only one of the many duties of a game warden.

(Fish and Game Photo)

First Chukar Season

In autumn of 1954 the first open season on chukar partridges in California began, extending for four days. Because of the tendency of this bird to frequent semi-arid mountainous regions, hunters were dispersed and patrol was necessitated over a wide area. In 1955 the chukar season was increased to 16 days, coinciding with the state-wide pheasant season. Because of the critical need for patrol of pheasant habitat, especially cooperative hunting areas, during the open season, it has proved fortunate that the chukar is not taken without a great deal of hard work by the hunter.

A two-day sage grouse season occurred in Lassen and Modoc Counties in both autumns of the biennium. Because the inland deer season had not yet begun in either year, little conflict with the need to patrol deer areas resulted, except to watch the activities of those who might be inclined to take deer illegally because their shooting would be masked by gunfire of grouse hunters.

During 1955 a special elk hunt was held to remove surplus animals from Inyo County. There were 150 permits issued, and wardens were assigned especially to patrol the county during the term of the hunt.

Special winter and antlerless deer hunts conducted during the biennium required an intensive patrol by wardens assigned to this duty. In 1954 some 3,625 permits to take anterless deer were issued; in 1955 permits approximated 16,170. Hunts of this type give rise to a number of violations by a small minority, and wardens were active in insuring game law observance.

Operating procedures on state cooperative hunting areas were changed during the biennium. The changes resulted during the 1955 season in a decrease in the number of wardens assigned to the areas in 1954. Although the changes did not decrease the total number of enforcement personnel in the areas (since department employees other than wardens were assigned to perform law enforcement duties), it was possible for more wardens to effectively patrol the State at large during this particularly busy period of November hunting.

Warden E. C. Fullerton models the standardized uniform adopted during the biennium by the department.
(Fish and Game Photo)

OTHER ACTIVITIES

Of each warden's day, some 30 percent is spent in wildlife conservation activities other than nominal law enforcement. Critical review of operations by the department during the biennium, aimed at rendering greater service for the same amount of money per license buyer, resulted in the addition of a number of tasks to the warden's variety of duties.

During 1955 wardens added to their back-country patrols the responsibility for inspection and operation of stream flow maintenance dams. This job, previously done by Inland Fisheries personnel, could more economically be performed by wardens while patroling the remote lakes and impoundments. Inspection and maintenance of the dams include the removal of debris from spillways, adjustment of water flow and the rendering of reports on the need for dam repair.

Performance of this job by wardens while on routine patrol did away with the need for Inland Fisheries personnel to schedule valuable peak-season days to this activity at a time when tourist demands for pack stock are heavy and available stock is correspondingly scarce.

Reserve Warden Ronald Ailey checking an angler's license.

(Fish and Game Photo)

Many Duties

In other fields of wildlife conservation, wardens contributed appreciable assistance in fish rescue work, cleaning and inspection of fish ladders, stream improvement, census taking, reporting of fish and game population trends, and appearances at public gatherings where a strong interest in fish and game matters is apparent.

One of the principal facets of a warden's job is his public service activities. Because of his extensive knowledge of the area in which he works, he is frequently called on to aid in finding persons lost in the mountains. He is expected to render his services whenever the public welfare so dictates, and he does so as a natural adjunct of his assigned duties.

Additional emergencies during the biennium such as fires, floods, drownings and other tragedies found the wardens rendering notable assistance to a number of public agencies as well as to private individuals.

RESERVE WARDEN PROGRAM

The number of reserve wardens in Southern California and the Sacramento Valley declined by 25 percent during the biennium. Raising of the requirements for qualification to compete in civil service examinations for the position of State Fish and Game Warden contributed to a degree to the drop in veteran reserves and potential replacements, since the requirements ruled out many of those who hoped to gain a civil service appointment. Despite this attrition, activation of three new reserve units in Central California enabled the force to maintain its strength.

Reserve wardens fill a distinct need in buttressing the work of the Wildlife Protection Branch. This is

particularly true of certain critical periods such as opening days of various seasons and heavily pressured week ends, when the regular wardens need help.

Applicants desiring a commission as a reserve warden must attend weekly training classes for 10 weeks and pass an examination before gaining an appointment. Receiving neither salary nor expenses, they team up on their tours of duty with regular wardens. Failure to conduct himself with consideration, courtesy and helpfulness toward the public is justification for immediate dismissal of a reserve from the program.

Tours of Duty

By terms of their appointments, reserve wardens are required to perform one tour of duty a month. Generally this service is conducted on a week end, although many reserves generously donate time far in excess of requirements. Consideration of the personal expense borne by each reserve warden leads to the conclusion that the ranks are filled only with men who are genuinely interested in the welfare of California's fish and game.

At the close of the biennium 11 reserve warden units, comprising 242 men, were active within the State. Units were located at Sacramento, Stockton, San Francisco, Fresno, Sonora, Tulare, Merced, Bakersfield, Los Angeles, Terminal Island (marine) and San Diego.

HUNTER SAFETY PROGRAM

At the beginning of the biennium Section 424 of the Fish and Game Code became effective. This statute, designed to reduce the number of hunting casualties, required that hunters under the age of 16, other than those having held a hunting license in prior years, be trained in proficiency with firearms as a condition of obtaining a hunting license. Upon satisfactory completion of a minimum four-hour course in the safe handling of guns, enrollees in these classes are issued a certificate of competence which, when presented to a license agent, furnishes proof of competence upon which issuance of a hunting license is based.

Much of the work of disseminating information, recruiting instructors and organizing training schools fell upon the Wildlife Protection Branch. Wardens worked prodigiously to assure success of the program. Most wardens gave cheerfully of their own free time to show films and speak to sportsmen's clubs and civic organizations concerning the need for safety with firearms.

At the close of the second year of the hunter safety law 41,740 youngsters had been granted certificates of competence and 4,654 adults had been certified as instructors by the department and the National Rifle Association, the organization with which the department has worked closely in carrying out the mandate of the Legislature.

During the biennium a schedule of marksmanship training for wardens was inaugurated. Ammunition allowances were provided and wardens were required to regularly submit a report of their scores.

In the spring of 1955 a five-man team was sent to the California State Championship Pistol Matches in San Diego. This team won two state championships in the sharpshooter class and took nine individual medals.

EQUIPMENT

Because Department of Fish and Game radios were assigned to an operating frequency used by the Division of Forestry, communications in the past were often unavoidably unsatisfactory. Peaks in work loads of both agencies occur during the summer and autumn, with a resultant heavy demand on radio facilities.

During the period of this report a complete new radio system was installed by the land and marine patrol of Region V. This included 82 mobile units in patrol cars, boats and an airplane, 10 land-based stations and seven relay stations. Now operating on a frequently assigned to exclusive use of the department's wardens, this system has been an invaluable asset to law enforcement.

To further improve the efficiency of the department's radio system, a budget request for $186,000 was made in 1955, so that a complete departmental radio system might be installed. The request was approved by the Legislature, and at the close of the biennium plans had been completed for early installation of the system.

MARINE PATROL

Two new patrol boats were acquired during the period of this report. One of them replaced the 25-foot *Grunion*, based at San Diego. The *Grunion*, which had been in operation continuously since 1947, was incapable of performing its duties further without undergoing an expensive overhaul. The new vessel, christened *Skipjack*, is 30 feet in length and is capable of a speed of 25 miles an hour. Based at San Diego, the *Skipjack* is used for patrol of the heavy sport and commercial fishing activities in that area.

In the spring of 1955 the *Rainbow III* was added to the patrol force in the Sacramento-San Joaquin Delta. Replacing the *Rainbow II*, which had outlived its usefulness, the new boat is also 30 feet in length. Purchased in October, 1954, its primary function is patrol of the striped bass and sturgeon fisheries and commercial boats netting salmon in the Carquinez Straits. The *Rainbow III* is based at Crockett.

Radar was installed during the biennium on the 32-foot patrol boat *Yellowtail*, operating out of Port Hueneme. Addition of this electronic equipment appreciably increased the effectiveness of the boat.

'ABOVE AND BEYOND THE CALL OF DUTY . . .'

Wardens Lend a Hand in Flood Emergency

Department of Fish and Game field personnel rescued approximately 100 persons from immediate danger of drowning during the floods of 1955 and assisted in the evacuation of hundreds of others.

But their greatest over-all contribution in averting further disaster was the fact that in many areas, including Yuba City and Klamath, Fish and Game wardens provided the only communication with the outside world for a period of several days during the height of the emergency.

At Yuba City Wardens Ross Waggoner of Yuba City and Edward Dennett of Wheatland foresaw the possibility of an emergency and when the floods struck, had set up an emergency radio communication system. Dennett gave the first warning of the Shanghai Bend break, and Waggoner relayed the warning to the sheriff's office. Robert Paillaix, Yuba City levee commissioner, credits them with preventing a staggering loss of life.

Crews under the direction of Patrol Captain Don Davison of Paradise, and Assistant Game Manager Albert Naylor of Gray Lodge, Butte County, rescued approximately 50 persons in the Yuba City area. Warden Jack Ferges of Roseville warned of the Nicolaus levee break, assisted in rescue and evacuation work, and maintained continuous radio communications.

In the stricken town of Klamath, Del Norte County, Wardens Otis Wright and Ralph Schlitzkus were the first law enforcement personnel in the area, and had the only radio contact with the sheriff's office.

In the Eel River Valley Wardens Lyle Null, Robert Perkins and Larry Werder rescued 16 persons and assisted in the evacuation of the town of Weott, brought in medical supplies and food, maintained radio communications and patrolled evacuated areas against looting.

Warden Jack McKerlie of Pt. Arena directed a dangerous rescue of 17 persons, including 15 children, cut off and in danger of drowning in the raging Gualala River. McKerlie for two days maintained the only communications into Pt. Arena.

In the Fernbridge area of Humboldt County Warden Robert Burge was the first rescue party to reach the area, and in addition helped evacuate the town of Orick. Warden Anderson Smith acted as rescue coordinator in Hayfork, Trinity County, for 24 straight hours, and had the only communication with outside. In Scott Valley Warden Robert Fraser maintained the only communication, and assisted in several rescues.

Warden Forrest McDermott served continuously for five days in the Santa Cruz emergency, and at one time had the only communication in the entire county.

Wardens Davis, Owen and White, working as a team with cars and boats, rescued 40 persons in the Visalia area. Wardens Becas and Burnett rescued six people in the Lemon Cove area, and then Becas returned to his own flooded home and evacuated his family and several neighbors. Burnett for a time provided the only radio contact with the Tulare County sheriff's office.

Scores of other fish and game people assisted in levee patrol, radio communication, patrol against looting, and directing rescue.

In none of the cases were the Fish and Game men ordered to this duty, the men accepting responsibility voluntarily. Fish and Game boats and radios and other equipment in many cases were on the scene before actual flooding took place and their use helped prevent damage and loss of life.

At least 75 department men contributed efforts far beyond the normal call of duty during this emergency period.

Wardens Gil Berg, left, and Hal Mefford in action during rescue operations at height of Yuba City flood.
(Fish and Game Photo by Capt. Don Davison)

APPENDICES

Shasta Dam, which backs up the headwaters of the Sacramento River.

(U. S. Bureau of Reclamation Photo)

SALMON MARKING AND RECOVERY,[1] 1950-1956

TABLE 1

Fins removed[2]	Brood year	Where released[3, 4]	Date of release	Number released	Ocean recoveries							River recoveries[5]							Grand total
					1951	1952	1953	1954	1955	1956	Total	1951	1952	1953	1954	1955	1956	Total	
KING	1949																		
D-LV		SR	Feb.-March 1950	235,248	1	17	17	1			36		6	11	2			19	55
D-RV		BC	March 1950	235,466	1	490	128	6			625	40	202	214	9			465	1,090
An-LV		BR	May 1950	132,734		4	9	1			14								14
KING	1951																		
D-Ad		BC	March 1952	505,933				23	15	3	41			4	6	3		13	54
D-Ad-LV		BC	Sept. 1952	41,850				7	16	3	26					2		2	28
Ad-LV (near mouth)		KR	April 1952	199,392			1		4	2	7								7
Ad-RV (above Highway 99)		KR	May 1952	213,608				14	55	11	80				35	97	5	137	217
Ad-An		MR	June 1952	99,300				4	13	2	19								19
KING	1952																		
D-Ad-RV		MR	Dec. 1953	12,100															
SILVER	1949																		
Ad-LV-RV		DNH	May-July 1951	1,772															
SILVER	1950																		
Ad-RV		DNH	May-July 1951	164,423			42				42			30				30	72
					2	511	197	56	103	21	890	40	208	259	52	102	5	666	1,556

[1] Actual number of recoveries not weighted by sampling efficiency. Ocean recoveries include those taken off British Columbia, Washington, Oregon, and California in random samples only. River recoveries include those made by spawning area survey crews and hatchery personnel.

[2] Abbreviations as follows: D—dorsal; V—ventral; L—left; R—right; An—anal; Ad—adipose.

[3] Eggs or fish were taken from the same stream in which they were released, with one exception. Those released in Big River, Mendocino County, were taken from Mad River.

[4] Abbreviations as follows: SR—Sacramento River; BC—Battle Creek; BR—Big River, Mendocino County; KR—Klamath River; MR—Mad River; DNH—Del Norte and Humboldt Counties.

[5] 1956 river data incomplete.

TABLE 2

FISH AND GAME PRESERVATION FUND
SUMMARY OF REVENUES, EXPENDITURES AND SURPLUS

	1954-55 Fiscal Year	1955-56 Fiscal Year
Total state revenue—all sources	$7,030,445	$7,333,214
Total expenditures	7,240,601	7,798,252
Sub-division of expenditures:		
Salaries and wages	3,839,712	4,159,061
Number of positions:		
Support		
Filled	(800.6)	(822.5)
Gross authorized	(835.8)	(867.4)
Federal aid		
Filled	(101.9)	(111.1)
Gross authorized	(119.0)	(120.0)
Operating expense	2,487,458	2,711,240
Equipment	263,735	233,204
Less reimbursements	—251,027	—277,540

Sub-division of expenditures—Continued	1954-55 Fiscal Year	1955-56 Fiscal Year
State Employees' Retirement	$400,879	$425,168
Pittman-Robertson—(state funds)	207,574	204,959
Dingell-Johnson—(state funds)	62,318	71,341
Board of control claims	969	14,333
Capital outlay	127,882	142,732
Pacific Marine Fisheries Commission	16,500	17,600
Marine Research Committee	84,601	96,654
Prior year adjustments to surplus	+82,799	+51,419
Accumulated surplus—June 30	5,244,185	4,830,066
Operating deficit (includes prior year adjustments)	—127,357	—414,119

TABLE 3

FISH AND GAME PRESERVATION FUND
STATEMENT OF REVENUE

	1954-55 Fiscal Year	1955-56 Fiscal Year
Department of Fish and Game, License Sales		
Angling	$3,835,168	$3,902,154
Commercial Hunting Club	900	1,225
Commercial Hunting Club Operator	320	400
Deer Tags	401,820	414,842
Fish Breeder	2,070	5,300
Fish Importer	15	10
Fish Canners and Processors	4,875	4,800
Wholesale Fish Dealers and Preservers	8,628	8,325
Fish Tags	11,957	10,929
Fishing Party Boat Permit	2,502	2,223
Boat Registrations	46,120	43,770
Salmon Tags	128	102
Game Breeders	8,980	10,310
Game Bird Club License	3,075	5,950
Game Bird Club Tags	1,154	1,308
Game Tags	2,116	1,875
Migratory Game Bird Feeding	790	560
Hunting	1,804,402	1,843,762
Kelp Harvesters	40	40
Commercial Fishermen	112,663	98,258
Trapping	882	916
Guide Licenses	1,800	1,930
Deer Meat Permits—Locker Plants	11,301	11,116
Deer Meat Permits—Wardens	2,565	2,065
Controlled Hunting Area Permits	51,222	66,462
Pheasant Tags	221,621	219,587
Special Big Game Hunts	9,286	80,906
Bass Tags	22	23
Napa Marsh Permits	3,093	1,578
Colorado River Permits	1,048	10,702
Perch Tags		54
Abalone Boat Registration		3,480
Shellfish Cultivators		200
Live Freshwater Bait Fish		1,990
Nutria Breeders		5,750
Totals, license sales	$6,550,563	$6,762,902
Less: Commissions retained by agents selling licenses	$—316,048	$ 321,639
Net revenue from license sales	$6,234,515	$6,441,263
Court fines	144,615	135,349
Taxes:		
Fish packers and fish dealers tax	327,215	367,569
Salmon tax	51,742	66,790
Kelp harvester tax	4,878	6,984
Oyster tax		356
Miscellaneous revenue	66,075	74,205
Total	$6,829,040	$7,092,516
Marine Research Committee, Taxes:		
Sardine	$66,088	$74,172
Mackerel	23,459	45,684
Anchovies	25,312	24,282
Herring	820	1,277
Squid	5,742	4,433
Total, Marine Research Committee	$121,421	$149,848
Total revenue excluding interest on investments	$6,950,461	$7,242,364
Interest on investments	79,984	90,850
Total revenue	$7,030,445	$7,333,214

TABLE 4

FISH AND GAME PRESERVATION FUND

1954-55 FISCAL YEAR EXPENDITURES	State	Federal aid	Total, state and federal
Wildlife Protection	$1,914,090		$1,914,090
Inland Fisheries	1,605,440		1,605,440
Game Management	1,110,077		1,110,077
Federal aid—research and development:			
Game	214,242	$642,728	856,970
Inland Fisheries	48,802	146,406	195,208
Marine Fisheries	15,856	47,569	63,425
Total—federal aid	$278,900	$836,703	$1,115,603
Marine Fisheries[1]	794,419		794,419
Regional management	531,143		531,143
Administrative services	427,355		427,355
Staff management services	241,216		241,216
Fixed charges:			
General administrative charges	98,272		98,272
Accident and death claims	44,298		44,298
Automobile insurance	22,463		22,463
Attorney general services	12,618		12,618
Total fixed charges	$177,651		$177,651
Conservation Education	129,072		129,072
Commission	31,239		31,239
Totals	$7,240,602	$836,703	$8,077,305

1955-56 FISCAL YEAR EXPENDITURES	State	Federal aid	Total, state and federal
Wildlife Protection	$2,106,698		$2,106,698
Inland Fisheries	1,860,991		1,860,991
Game Management	1,245,374		1,245,374
Federal aid—research and development:			
Game	213,347	$640,041	853,388
Inland Fisheries	55,726	167,178	222,904
Marine Fisheries	18,774	56,322	75,096
Total—federal aid	$287,847	$863,541	$1,151,388
Marine Fisheries[2]	856,584		856,584
Regional management	410,262		410,262
Administrative services	406,482		406,482
Staff management services	240,619		240,619
Fixed charges:			
General administrative charges	90,624		90,624
Accident and death claims	42,086		42,086
Automobile insurance	19,565		19,565
Attorney general services	15,307		15,307
Total fixed charges	$167,582		$167,582
Conservation Education	178,111		178,111
Commission	38,202		38,202
Totals	$7,798,752	$863,541	$8,662,293

[1] Includes Marine Research Committee Expenditures of $84,601 and Pacific Marine Fisheries Commission of $16,500.

[2] Includes Marine Research Committee Expenditures of $96,654 and Pacific Marine Fisheries Commission of $17,600.

TABLE 5

HATCHERY REARED WARMWATER FISH PLANTED

Species	Number	
	1954-55	1955-56
Largemouth black bass	197,655	358,585
Smallmouth black bass	4,000	10,800
Golden shiner	34,640	3,345
Fathead minnow	169,760	494,752
Bluegill sunfish		680
Pumpkin seed sunfish		13,548
Redear sunfish		32,444
Total	406,001	914,154

TABLE 6

TROUT AND SALMON PLANTING TRENDS

Year	Fingerling		Subcatchable*		Catchable	
	Number	Pounds	Number	Pounds	Number	Pounds
1949-50	16,290,943	70,542			2,501,182	417,855
1950-51	14,918,164	61,901			2,833,599	468,339
1951-52	11,815,287	40,182			3,675,305	539,554
1952-53	13,452,418	40,826			4,580,840	747,721
1953-54	13,512,282	46,747			5,261,740	796,384
1954-55	10,294,133	49,261			7,599,905	1 191,428
1955-56	18,119,846	85,020	86,535	7,416	7,584,721	1,240,576

* 1955-56 First year subcatchables were separated.

TABLE 7

FISH SALVAGED AND TRANSPLANTED

Species	Number	
	1954-55	1955-56
Warmwater Fish		
Striped bass	46	238
Largemouth black bass	945,950	599,282
Smallmouth black bass	57,128	82,410
Warmouth bass	13,000	205
Bluegill sunfish	98,763	39,521
Green sunfish	2,613	2,008
Redear sunfish	13	8,766
Black crappie	76,330	2,515
White crappie	292	1,626
Sacramento perch	225	266
Viviperous perch	120	
Golden shiner	15,408	6,020
Fathead minnow	16,000	25,700
Threadfin shad	2,132	185
Channel catfish	1,232	19,642
White catfish	4,452	73,827
Brown bullhead	7,125	17,433
Red Plains shiner		2,000
Total	1,240,829	881,639
Salmon		
Silver	13,203	24,955
King	153,900	2,857
Total	167,103	27,812
Trout		
Rainbow	1,554	13,216
Brown	293	1,578
Eastern brook	500	
Cutthroat	2	
Steelhead	799,212	523,401
Total	801,561	538,195
Others		
Shortfin corvina	114	1,968
Orangemouth corvina	4	56
Northern anchovy	5,000	
Tortuava		
Total	5,118	2,032
GRAND TOTAL	2,214,611	1,449,678

TABLE 8

1954-55 FISCAL YEAR EXPENDITURES

Support		
Salary and wages	$23,886.00	
Operating expenses	11,460.00	
Equipment		
		$35,346.00
Contribution to Retirement System		1,666.00
Total Support		$37,012.00
Capital Outlay Projects		
Fish hatchery and stocking		$233,920.00
Warmwater and other fish projects		18,391.00
Flow maintenance and stream improvement		36,803.00
Fish screen and ladder		7,064.00
Game farm		
Upland game		—179.00
Waterfowl		1,708,257.00
General		5,500.00
Total Capital Outlay		$2,009,756.00
TOTAL EXPENDITURES		$2,046,768.00

TABLE 9

1955-56 FISCAL YEAR EXPENDITURES

Support		
Salary and wages	$28,294.00	
Operating expenses	21,178.00	
Equipment	173.00	
		$49,645.00
Contributions to Retirement System		1,758.00
Total Support		$51,403.00
Capital Outlay Projects		
Fish hatchery and stocking projects		$203,905.00
Warmwater and other fish projects		147,831.00
Flow maintenance and stream improvement		76,513.00
Fish screen and ladder		42,000.00
Game farm		
Upland game		704,801.00
Waterfowl		1,158.00
General		1,326.00
Special		
Total Capital Outlay		$1,177,534.00
TOTAL EXPENDITURES		$1,228,937.00

TABLE 10

FARM PONDS

July 1, 1954 to June 30, 1956 (Inclusive)

Region	Number of applications	Number of ponds stocked†
I	60*	40
II	121	95
III	128	74
IV	96	72
V	123	95
Totals	528*	376

* Estimated.
† Includes ponds stocked with fish purchased by owners from private breeders.

TABLE 11

INITIAL STREAM AND LAKE SURVEYS

July 1, 1954 to June 30, 1956 (Inclusive)

Region	Streams	Lakes
I	32	88
II		102
III	35	10
IV	10	41
V		3
Totals	107	244

TABLE 12

CREEL CENSUSES

July 1, 1954 to June 30, 1956 (Inclusive)

Name of water	County
REGION I	
Castle Lake	Siskiyou
Medicine Lake	Siskiyou
Klamath River	Siskiyou and Del Norte
Shasta River	Siskiyou
Scott River	Siskiyou
Eagle Creek	Trinity
Cedar Creek	Modoc
Big Sage Reservoir	Modoc
Big, Stone, Freshwater, and Clam Beach Lagoons	Humboldt
Eel River, South Fork	Humboldt
Sacramento River and tribs. (Mill, Battle, and Deer creeks)	Shasta and Tehama
Trinity River	Trinity
Smith River	Del Norte
REGION II	
American River	Sacramento
Nimbus Reservoir	Sacramento
Folsom Reservoir	Sacramento and Placer
Ross Reservoir	Calaveras
Hunters Reservoir	Calaveras
Licking Fork	Calaveras
Schaad's Reservoir	Calaveras
Love Creek	Amador
Tabaud Reservoir	Amador
Angels Creek	Amador
Benner Creek	Plumas
Cold Stream Creek	Plumas
Indian Creek	Plumas
Eureka Lake	Plumas
Lost Creek	Plumas
Mud Creek	Plumas
Oregon Creek	Yuba
Poplar Creek	Plumas
Prosser Creek	Nevada
Rice Creek	Plumas
Upper and Lower Scotts Flat Reservoir	Nevada
Slate Creek	Yuba
Spanish Creek	Plumas
Little Truckee River	Sierra
Warner Creek	Plumas
Big Creek	Plumas
Fall River	Butte
Canyon	Sierra
Dry Creek	Yuba
Alder Creek	El Dorado
Silver Creek	El Dorado
Gerle Creek	El Dorado
Webber Creek	El Dorado
Rubicon River	El Dorado
Pilot Creek	El Dorado
Long Canyon Creek	Placer
Duncan Creek	Placer
Bullion Creek	Placer
Shirttail Canyon Creek	Placer
Forest Creek	Calaveras
Blue Creek	Calaveras
Lakes Basin Recreation Area (8 lakes)	Plumas and Sierra
Butte Creek	Butte
Sacramento River	Glenn, Butte, Colusa
American River (South, Middle, North, and Silver Forks)	Placer and El Dorado
Mokelumne River (Middle, South, and North Forks)	Amador and Calaveras
Feather River (North, Middle, and South Forks; East and Hamilton Branches)	Plumas, Butte, and Sierra
REGION III	
Alameda Creek	Alameda
San Lorenzo River	Santa Cruz
Gualala River	Mendocino and Sonoma
San Vicente Creek	Santa Cruz
Russian River and tribs.	Mendocino and Sonoma
Gazos Creek	San Mateo
Lake Merced	San Francisco
Dennison Creek Reservoir	San Mateo
Higgins Creek Reservoir	San Mateo
Lexington Reservoir	Santa Clara
Stevens Creek Reservoir	Santa Clara
Alpine Lake	Marin
Lagunitas Lake	Marin
Bon Tempe Lake	Marin
Kent Lake	Marin
Rodeo Lagoon	Marin
Upper Blue Lake	Lake
Lake Pillsbury	Lake
Rector Reservoir	Napa
Rice Fork	Lake
Eel River	Lake
Salmon Creek	Lake
Squaw Creek	Lake
Pescadero Creek	San Mateo
Conn Creek	Napa
Eel River, Middle Fork	Mendocino
REGION IV	
Brush Creek	Tulare
Pine Flat Reservoir	Fresno
Don Pedro Reservoir	Tuolumne
Merced River	Mariposa
Sequoia Lake	Fresno
Shaver Lake	Fresno
Hume Lake	Fresno
Kern River	Kern and Tulare
Strawberry Lake	Tuolumne
Los Banos Ponds	Merced
San Joaquin River	Fresno and Madera
Kings River	Fresno
Huntington Lake	Fresno
REGION V	
Colorado River	Riverside and Imperial
Sabrina Lake	Inyo
South Lake	Inyo
Bishop Creek	Inyo
Little Rock Reservoir	Los Angeles
San Gabriel River	Los Angeles
Convict Lake	Mono
June Lake	Mono
Mary Lake	Mono
Rock Creek Lake	Mono
Silver Lake	Mono
Twin Lakes (Mammoth Creek)	Mono
Twin Lakes (Robinson Creek)	Mono
Convict Creek	Mono
Mammoth Creek	Mono
Rock Creek	Mono
Rush Creek	Mono
Arrowhead Lake	San Bernardino
Gregory Lake	San Bernardino
El Capitan Reservoir	San Diego
San Vicente Reservoir	San Diego
Cachuma Reservoir	Santa Barbara
Matilija Reservoir	Ventura
Big Bear Lake	San Bernardino
Sutherland Reservoir	San Diego

TABLE 13

APPLICATIONS TO APPROPRIATE WATER

July 1, 1954 to June 30, 1956 (Inclusive)

Region	Number of applications	Number of special field inspections made	Number of protests filed
I	132	29	9
II	468	35	49
III	193	48	15
IV	168	16	11
V	110	39	8
Total	1,071	167	92

PREDATORY BIRD BOUNTIES PAID BY DEPARTMENT TABLE 14

County	Number bountied			
	Crows		Magpies	
	1954	1955	1954	1955
Contra Costa	180	20		
Glenn	66			
Inyo				56
Lake		119		
Lassen		25		326
Modoc			270	
Riverside		7		8
San Bernardino		48		
San Joaquin	341			
Shasta	23	40		
Stanislaus	38			
Ventura	792			
Yolo	770	568		
Totals	2,210	827	270	390

TABLE 15

WATERFOWL MANAGEMENT AREA OPERATIONS

Area	Acreage open to hunting		Scheduled seasonal shooter capacity		*Actual number hunters using area		Number waterfowl bagged		Average bag per hunter	
	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955
Madeline Plains	2,080	2,000	5,280	1,700	918	250	2,018	548	2.2	2.2
Honey Lake	3,000	3,000	4,950	4,500	2,237	742	2,737	2,423	1.2	3.3
Gray Lodge	4,280	5,000	1,840	2,600	2,996	3,138	9,604	10,960	3.1	3.5
Colusa	1,100	1,100	1,840	2,080	2,496	2,948	8,316	10,990	3.3	3.7
Sutter	1,060	1,100	1,725	1,280	2,281	1,953	5,622	5,907	2.4	3.0
Grizzly Island	5,000	5,000	16,500	11,500	8,223	9,824	24,853	33,448	3.0	3.4
Merced	960	1,000	1,200	2,000	826	1,615	1,280	3,712	1.5	2.3
Los Banos	1,500	1,530	1,680	2,900	1,889	2,613	3,821	4,497	2.0	1.7
San Luis Wasteway	1,500	1,500	3,300	2,800	3,698	3,110	10,810	9,246	2.9	3.0
Imperial†	3,750	4,520	12,450	12,700	4,567	5,525	8,578	11,381	1.9	2.0
Welch Co-ops										
Grace	1,500		1,380		838		1,276		1.6	
Maxwell	5,600		3,150		1,632		2,139		1.3	
Mendota		7,500		4,350		3,101		6,132		2.0
Totals	31,330	33,250	55,295	48,410	32,601	34,845	81,054	99,244	2.5	2.9

* Actual number of hunters may exceed scheduled capacity due to hunters using areas as replacements of original hunters who have left the area.
† Includes Hazard, Pumice, Poe, Finney-Ramer, Wister and Imperial National Units.

TABLE 16

HATCHERY REARED TROUT AND SALMON DISTRIBUTION

1954-55 FISCAL YEAR

County	Catchable Rainbow	Trout Fingerlings						Salmon Fingerlings		
		Rainbow	Steelhead	Cutthroat	Brook	Brown	Golden	Silver	Kokanee	King
Alameda	27,450									
Alpine	[1]153,887	172,711			19,740		1,920			
Amador	70,972	91,375			17,500					
Butte	112,707									
Calaveras	58,650				2,013					
Colusa	13,415									
Del Norte			324,128							
El Dorado	175,962	400,168		20,250	350,687	17,500				
Fresno	207,596	490,603			106,380		192,120			
Glenn	2,584	1,040								
Humboldt		75,180	202,802	114,338						
Inyo	515,581	177,418			55,434	427,514	27,600			
Kern	207,099	117,207								
Lake	56,268									
Lassen	97,801	285,672			37,826				450,000	
Los Angeles	318,418					1,000				
Madera	37,400	205,106			59,945		4,800			
Marin	175,065	152,345								
Mariposa	73,679	291,373			117,795		4,800			
Mendocino	32,674									
Modoc	50,739	31,780				108,360				
Mono	[2]1,351,112	283,315		264,035	289,904	240,435	13,200			
Monterey	78,590									
Napa	57,954									
Nevada	141,083	47,995		30,000	5,460				90,210	
Orange	12,400									
Placer	143,467	290,187			24,000					
Plumas	258,068	74,783			4,000				158,280	7,500
Riverside	136,410					3,150				
Sacramento		200,240								
San Bernardino	775,532	46,270				1,000			200,000	
San Diego	80,390									
San Francisco	93,397	365,818								
San Joaquin		494,210								
San Luis Obispo	80,067									
San Mateo	73,992									
Santa Barbara	53,165	399,732								
Santa Clara	78,981									
Santa Cruz	90,513									
Shasta	332,737	229,008			36,160	30,000				
Sierra	139,591	74,185				20,095				
Siskiyou	223,819	112,549			108,301	4,200				202,650
Solano	10,058									
Tehama	212,130	26,000								
Trinity	17,313	263,754		10,005	44,141	2,100				
Tulare	265,359	105,229			10,175		13,920			
Tuolumne	325,713	225,722			71,985		13,800			
Ventura	176,777									
Yuba	3,340									
Totals	7,599,905	5,730,975	526,930	438,628	1,361,446	855,354	272,160		898,490	210,150

[1] 1,386 Cutthroat.
[2] 3,250 Brown.

COOPERATIVE PHEASANT HUNTING AREA OPERATIONS

TABLE 17

Area	Acreage open to hunting		Scheduled seasonal shooter capacity		Actual number of hunters using area		Number of pheasant bagged		Average birds bagged per hunter	
	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955
Gazelle	6,160	5,775	6,000	8,000	1,882	1,500	691	743	0.37	0.41
McArthur	6,580	5,860	7,000	8,000	1,371	1,055	795	905	0.58	0.86
Butte Creek	4,140	4,249	4,140	6,688	4,190	4,577	1,433	557	0.23	0.35
College City	5,268	5,460	5,130	8,688	3,300	4,126	1,477	2,367	0.44	0.59
Courtland	3,431	4,414	2,750	4,320	2,015	3,147	464	442	0.22	0.40
Grimes	19,143	17,901	18,200	24,000	4,533	[3]3,377 [4]756	1,810	2,014	0.39	0.64
Maxwell (Welch)	6,750		5,000		1,714		660		0.38	
Meridian	6,396		3,820		3,020		1,577		0.36	
Natomas	10,496	11,661	9,500	16,000	8,600	12,337	2,000	2,156	0.22	0.50
Plainfield	6,323	5,228	3,960	5,296	4,265	4,379	1,411	1,926	0.32	0.46
Ryer Island	11,230	11,193	6,500	11,200	3,928	4,915	1,467	2,033	0.36	0.42
Staten Island	8,315	7,400	5,500	8,000	4,049	4,809	1,574	1,934	0.38	0.41
Sutter Basin	11,797		10,000		4,820		2,310		0.49	
Twitchell Island	5,047	4,690	1,850	3,760	3,482	4,525	971	1,167	0.27	0.33
Tyler Island	6,273	6,554	3,250	6,240	3,508	4,543	1,200	2,007	0.33	0.45
Union Island	13,560	13,506	6,120	10,400	3,877	5,225	1,007	1,339	0.25	0.26
Yolo	15,076	16,826	7,280	12,000	5,293	7,360	2,195	3,546	0.40	0.49
Firebaugh	20,500	21,000	8,000	12,800	5,880	5,375	2,553	2,755	0.42	0.54
Merced	5,800	8,500	4,000	6,400	5,119	5,157	2,509	2,072	0.47	0.41
Etiwanda	5,400	6,000	4,000	8,000	6,211	14,014	2,067	4,020	0.33	0.29
Lakeside	5,200	5,200	3,000	6,400	4,268	5,891	1,949	2,707	0.46	0.46
Lancaster	7,000		6,000		6,912		2,360		0.34	
Totals	189,885	161,417	131,000	165,892	92,237	97,158	34,480	34,990	0.37	0.36

[1] Daily permits. [2] Seasonal permits.

TABLE 18

HATCHERY REARED TROUT AND SALMON DISTRIBUTION
1955-56 FISCAL YEAR

County	Catchable Rainbow	Trout Fingerlings						Salmon Fingerlings		
		Rainbow	Steelhead	Cutthroat	Brook	Brown	Golden	Silver	Kokanee	King
Alameda	28,197									
Alpine	182,551	26,985		133,730	62,020		2,000			
Amador	69,914	236,792			20,960				80,940	
Butte	109,515									
Calaveras	69,931				2,002					
Colusa	13,530									
Del Norte			253,330							
El Dorado	143,815	1,772,832		32,805	332,896					
Fresno	377,143	444,692			141,143		99,500			
Glenn	2,530	1,508								
Humboldt		126,168	93,735	103,731	4,012			59,932		
Inyo	[5]618,489	245,920			17,020	179,676	15,200			
Kern	227,485	233,115								
Lake	68,892					50,000				
Lassen	47,823	11,637	100,800						243,000	
Los Angeles	239,320					16,260				
Madera	82,584	118,292			58,931					
Marin	107,894	237,600								
Mariposa	66,875	457,576			15,855					
Mendocino	13,602		170,700							479,952
Modoc	29,791	47,713		73,640						
Mono	[2]1,644,780	381,013		248,100	95,239	476,830	31,530			
Monterey	86,967									
Napa	46,470									
Nevada	226,035	164,879		34,200	147,699				150,275	
Orange	18,780									
Placer	19,975	1,278,406			31,535					
Plumas	[3]180,746	456,254			90,221	16,588				
Riverside	100,390									
Sacramento		240,108								2,205,620
San Bernardino	649,020	2,560				25,490				
San Diego	61,200					4,000				
San Francisco	152,305	766,962								
San Luis Obispo	81,410									
San Mateo	88,346									
Santa Barbara	16,070	290,410								
Santa Clara	56,154									
Santa Cruz	95,933		58,296							
Shasta	274,673	28,338	1,050	750	5,005			[7]900		
Sierra	[4]127,148	121,327		30,000	[6]63,417				129,000	
Siskiyou	[5]176,280	213,162			97,340	35,000				2,599,863
Solano		26,240								
Sonoma	4,096									
Tehama	161,743							[8]43,025		
Trinity	7,225	109,427			30,009					
Tulare	321,080	86,117			40,959		27,900			
Tuolumne	[9]354,844	326,864			85,273				57,020	
Ventura	172,985					5,000				
Yuba	2,795									
Totals	7,627,331	8,452,897	577,111	757,756	1,341,506	808,844	176,130	103,857	660,235	5,285,435

[1] 7,430 Brown.
[2] 7,430 Brown.
[3] 16,610 Subcatchables.
[4] 800 Brown.
[5] 20,513 Splake.
[6] 840 Brown
[7] Subcatchables.
[8] Subcatchables.
[9] 26,000 Subcatchables.

TABLE 19

TOTAL ARRESTS FOR PERIOD OF 54 YEARS

1902-1904	550	1930-1932	5,237
1904-1906	774	1932-1934	3,795
1906-1908	1,192	1934-1936	4,535
1908-1910	1,771	1936-1938	6,382
1910-1912	2,063	1938-1940	7,444
1912-1914	1,993	1940-1942	7,262
1914-1916	2,087	1942-1944	4,298
1916-1918	1,797	1944-1946	5,902
1918-1920	1,891	1946-1948	11,331
1920-1922	2,258	1948-1950	12,947
1922-1924	2,715	1950-1952	12,802
1924-1926	3,207	1952-1954	16,271
1926-1928	4,390	1954-1956	18,202
1928-1930	5,388		

TABLE 20

CALIFORNIA REGULAR SEASON DEER KILL
(ARCHERY TAGS INCLUDED)

County of kill	Yearly average 1927-1951	1952	1953	1954	1955	Percent change from 1954
Alameda	348	627	763	911	639	−30
Alpine	523	1,277	1,638	1,765	1,896	+7
Amador	198	322	485	550	418	−24
Butte	448	849	1,040	1,229	1,158	−6
Calaveras	288	413	497	694	636	−8
Colusa	350	541	356	592	548	−7
Contra Costa	59	200	232	311	175	−44
Del Norte	30	28	33	46	55	+20
El Dorado	801	937	1,185	1,637	1,394	−15
Fresno	1,508	1,949	2,407	2,850	2,526	−11
Glenn	642	740	606	687	780	+14
Humboldt	1,233	1,792	2,323	3,055	3,408	+12
Imperial	5	16	23	5	14	+180
Inyo	424	308	593	606	493	−19
Kern	372	655	1,032	965	1,118	+16
Kings	13	29	30	54	36	−33
Lake	1,379	2,056	2,146	2,549	2,479	−3
Lassen	1,398	1,962	1,519	2,643	3,366	+27
Los Angeles	690	572	629	926	977	+6
Madera	494	665	745	939	842	−10
Marin	486	832	885	1,048	901	−14
Mariposa	221	232	248	328	336	+12
Mendocino	2,267	4,252	4,394	5,232	4,587	−12
Merced	101	388	388	355	341	−4
Modoc	1,922	1,794	1,076	2,151	2,535	+18
Mono	557	1,442	2,098	2,565	1,899	26
Monterey	1,017	1,825	2,023	2,685	2,577	−4
Napa	685	1,220	1,161	1,386	1,329	−4
Nevada	601	972	1,277	1,750	1,149	−34
Orange	90	129	173	171	207	+21
Placer	431	531	671	833	686	−18
Plumas	1,507	1,671	2,285	2,762	2,543	−8
Riverside	390	658	354	417	412	−1
Sacramento	6	18	21	18	26	+44
San Benito	460	1,174	1,408	1,662	1,513	−9
San Bernardino	247	628	455	476	561	+18
San Diego	455	719	792	904	1,306	+44
San Joaquin	24	43	60	64	71	+11
San Luis Obispo	677	1,115	1,503	2,077	1,933	−7
San Mateo	111	167	139	140	157	+12
Santa Barbara	657	708	994	1,314	1,307	−1
Santa Clara	611	1,051	1,172	1,695	1,434	−15
Santa Cruz	110	118	166	257	219	−15
Shasta	1,115	1,940	2,566	3,423	3,167	7
Sierra	658	795	1,032	1,322	1,014	−23
Siskiyou	1,843	2,187	2,768	4,036	4,220	+5
Solano	69	126	113	139	143	+3
Sonoma	906	1,553	1,679	1,979	1,586	−20
Stanislaus	147	371	471	608	451	−26
Sutter	1	2			2	+200
Tehama	1,372	1,623	2,932	4,180	3,137	−25
Trinity	905	1,045	1,220	1,242	1,811	+46
Tulare	1,150	1,087	1,174	1,662	1,594	−4
Tuolumne	616	956	1,447	1,705	1,256	26
Ventura	578	856	784	894	1,065	−19
Yolo	237	334	349	537	392	−27
Yuba	96	167	244	368	205	44
Not given	3		188	203	96	53
State-wide totals	34,532	50,667	58,992	75,602	71,126	−6
Deer tag sales	175,448	369,149	370,938	397,566	400,000	est. +0.6

TABLE 21

SUMMARY OF DEPARTMENT OF FISH AND GAME LANDS
1955
GAME MANAGEMENT

	Leased lands	Acreage	Cost
WATERFOWL MANAGEMENT AREAS			
Honey Lake, Lassen County		4,819.70	$90,784.09
Madeline Plains, Lassen County		5,176.10	47,353.20
Sheepy Ridge, Siskiyou County		320.00	1,034.00
Gray Lodge, Butte and Sutter Counties		6,735.51	1,044,297.77
Grizzly Island, Solano County		8,600.00	659,929.42
Suisun, Solano County		1,887.00	71,875.50
Los Banos, Merced County		3,000.00	104,241.40
Mendota, Fresno County		8,536.57	1,071,675.49
San Luis Wasteway, Merced County	2,886.95		
Finney-Ramer, Imperial County		2,064.43	88,405.05
Hazard Fleet, Imperial County		535.24	47,775.52
Wister area, Imperial County	3,880.00	5,010.00	954,589.08
Totals	6,766.95	46,684.55	$4,181,960.52
WINTER DEER RANGES			
Doyle, Lassen County		13,502.91	$37,807.76
Tehama, Tehama County		42,896.90	212,518.86
Totals		56,399.81	$250,326.62
STATE GAME FARMS			
Redding, Shasta County	*	14.00	$4,294.00
Chico, Butte County	Gift	12.00	0.00
Marysville, Yuba County	Gift	11.00	0.00
Yountville, Napa County	*	72.00	0.00
Brawley, Imperial County—part of Finney-Ramer WMA			0.00
Los Serranos, San Bernardino County	Gift	29.00	0.00
Totals		138.00	$4,294.00
TOTALS Waterfowl Management Areas	6,766.95	46,684.55	4,181,960.52
Winter Deer Ranges		56,399.81	250,326.62
State Game Farms		138.00	4,294.00
GRAND TOTAL	6,766.95	103,222.36	$4,436,581.14

* Some of this acreage used for general departmental uses other than game farms.

GAME BIRD RELEASES

TABLE 22

Liberation of Game Farm Birds January 1, 1954, through December 31, 1955

County	Ring-neck	Reeves	Chukars	Total
Alameda	678			678
Alpine	220			220
Butte	6,417			6,417
Colusa	4,002			4,002
Contra Costa	20			20
Del Norte		92		92
Fresno	9,471			9,471
Glenn	135			135
Humboldt	230			230
Imperial	10,144		1,409	11,553
Inyo	6,138			6,138
Kern	10,494			10,494
Kings	1,203			1,203
Lake	556			556
Lassen	2,255			2,255
Los Angeles	2,900			2,900
Madera	2,011	64		2,075
Mendocino	85			85
Merced	12,613			12,613
Modoc	130			130
Mono	100			100
Monterey	3,697			3,697
Napa	803			803
Nevada	342			342
Placer	1,047			1,047
Riverside	3,533		1,705	5,238
Sacramento	12,064			12,064
San Bernardino	8,344		1,616	9,960
San Diego	5,356			5,356
San Joaquin	9,632			9,632
San Mateo	85			85
Santa Clara	326			326
Shasta	2,293			2,293
Siskiyou	3,911			3,911
Solano	9,255			9,255
Sonoma	3,631	32		3,663
Sutter	4,636			4,636
Tehama	593			593
Tulare	3,601			3,601
Ventura			30	30
Yolo	9,406			9,406
Yuba	2,532			2,532
Totals	154,889	188	4,760	159,837

TABLE 23

CHEMICAL CONTROL OF UNDESIRABLE FISH POPULATIONS

July 1, 1954 to June 30, 1956 (Inclusive)

Name of water	County	Surface area in acres: At time of treatment	Surface area in acres: When full	Date	Species restocked
REGION I					
West Valley Reservoir	Modoc	605	1,000	Nov. 1955	Cutthroat trout
Kelley Lake	Siskiyou	9	9	Oct. 1955	Eastern brook
Duncan Reservoir	Modoc	60	200	Oct. 1954	Rainbow trout
Pine Creek	Lassen	6 mi.	.....	Oct. 1954	Eagle Lake trout
REGION II					
Lower Loch Leven Lake	Placer	11	11	Oct. 1955	Eastern brook trout
Weaver Lake	Nevada	67	104	Sept. 1955	Rainbow trout
Round Lake	Nevada	4.8	4.8	Sept. 1955	Rainbow trout
Long Lake	Nevada	3.9	3.9	Sept. 1955	Rainbow trout
Little Island Lake	Nevada	6.5	6.5	Sept. 1955	Rainbow trout
Island Lake	Nevada	34.4	52.2	Sept. 1955	Rainbow trout
Lilyput Pond	Nevada	1.8	1.8	Sept. 1955	*
Shotgun Lake	Nevada	5.7	8.6	Sept. 1955	Rainbow trout
Upper Crooked Lake	Nevada	2.7	2.7	Sept. 1955	Rainbow trout
Middle Crooked Lake	Nevada	2.0	2.0	Sept. 1955	Rainbow trout
Lower Crooked Lake	Nevada	7.4	7.4	Sept. 1955	Rainbow trout
Big Bear Lake	Plumas	24.6	24.6	Sept. 1955	Rainbow trout
Little Bear Lake	Plumas	4.1	4.1	Sept. 1955	Rainbow trout
Grassy Lake	Plumas	11.0	11.0	Sept. 1955	Eastern brook
Long Lake	Placer	10.7	10.7	Sept. 1955	Rainbow trout
Upper Cascade	Placer	27.5	84.0	Sept. 1955	Rainbow trout
Lower Cascade	Placer	14.0	34.5	Sept. 1955	Rainbow trout
Little Catfish Lake	Nevada	7.4	7.4	Sept. 1955	Eastern brook
Echo Lake	Plumas	29.0	29.0	Aug. 1955	Eastern brook
Silver Fork Log Pond	El Dorado	.5	.5	May 1956	*
Crystal Lake	Plumas	11.1	11.1	Aug. 1954	Eastern brook
Devils Peak Lake	Placer	3.6	3.6	Aug. 1954	Eastern brook
Dan Lake	Placer	1.6	1.6	Aug. 1954	Eastern brook
Frog Lake	Alpine	6.0	6.0	Aug. 1954	Cutthroat
Campbell Lake	Plumas	6.8	6.8	Sept. 1954	Eastern brook
Long Lake	Plumas	14.6	14.6	Sept. 1954	Eastern brook
Grassy Lake	Plumas	7.3	7.3	Sept. 1954	*
Saddle Lake	Plumas	9.0	9.0	Sept. 1954	Eastern brook
Lower Bucks Lake	Plumas	15.0	130.0	Sept. 1954	Rainbow trout
Upper Angora Lake	El Dorado	14.6	14.6	Sept. 1954	Cutthroat
Lower Angora Lake	El Dorado	8.3	8.3	Sept, 1954	Cutthroat
Woods Lake	Alpine	16.0	16.0	Sept. 1954	Rainbow trout
Elephant Rock Lake	Alpine	7.3	7.3	Sept. 1954	Eastern brook
Summit Lake	Alpine	12.5	12.5	Sept. 1954	Eastern brook
Upper Lindsey Lake	Nevada	15.0	22.0	Sept. 1954	Eastern brook
Lower Lindsey Lake	Nevada	21.0	29.0	Sept. 1954	Eastern brook
View Lake	Nevada	2.7	4.4	Sept. 1954	Eastern brook
REGION III					
Mackaye Radio Pond	San Mateo	1	1	Nov. 1954	Largemouth bass
Giannini Pond	San Mateo	1	1	Nov. 1954	Largemouth bass
McCreary Reservoir	Lake	90	100	Oct. 1955	Largemouth bass
Deitert Reservoir	Lake	30	70	Oct. 1955	Largemouth bass
Russian River, West Branch	Mendocino	11 mi.	.....	Sept. 1954	None†
Forsythe Creek	Mendocino	7 mi.	.....	Sept. 1954	None†
Mill Creek	Mendocino	¼ mi.	.....	Sept. 1954	None†
Akerman Creek	Mendocino	6 mi.	.....	Sept. 1954	None†
Robinson Creek	Mendocino	5 mi.	.....	Sept. 1954	None†
McNab Creek	Mendocino	3 mi.	.....	Sept. 1954	None†
Feliz Creek	Mendocino	7 mi.	.....	Sept. 1954	None†
Pieta Creek	Mendocino	5 mi.	.....	Sept. 1954	None†
Coleman Creek	Mendocino	¼ mi.	.....	Sept. 1954	None†
Cummingsky Creek	Mendocino	3 mi.	.....	Sept. 1954	None†
Sulphur Creek	Mendocino	2 mi.	.....	Sept. 1954	None†
Middle Creek	Mendocino	2 mi.	.....	Sept. 1954	None†
REGION III—Contd.					
Green Valley Creek	Sonoma	7 mi.	.....	Oct. 1954	None†
Porter Creek	Sonoma	1 mi.	.....	Oct. 1954	None†
Austin Creek	Sonoma	6 mi.	.....	Oct. 1954	None†
Mark West Creek	Sonoma	9 mi.	.....	Oct. 1954	None†
Santa Rosa Creek	Sonoma	11 mi.	.....	Oct. 1954	None†
Laguna de Santa Rosa Creek	Sonoma	6 mi.	.....	Oct. 1954	None†
Windsor Creek	Sonoma	2 mi.	.....	Oct. 1954	None†
Russian River	Mendocino and Sonoma	85 mi.	.....	Nov. 1954	Smallmouth bass†
Dry Creek	Sonoma	15 mi.	.....	Aug. 1955	None*
Putah Creek	Lake and Napa	35 mi.	.....	Sept.-Oct. 1955	Smallmouth bass Largemouth bass White catfish Brown trout
Pope Creek	Napa	6 mi.	.....	Sept. 1955	None
Buckanort Creek	Napa	4 mi.	.....	Sept. 1955	Brown trout
REGION IV					
Los Banos Pond	Merced	10	10	Feb. 1955	Bluegill sunfish Largemouth bass Fathead minnow Green sunfish
Sequoia Lake	Fresno	85	85	Sept. 1954	Rainbow trout
Dallas Warner Reservoir‡	Stanislaus	280	3,800	Nov. 1954	Largemouth bass Bluegill sunfish Black crappie Fathead minnow Brown bullhead White catfish
Catfish Lake	Tuolumne	4	5	Aug. 1955	Eastern brook (proposed)
Yosemite Lake	Merced	150	500	Dec. 1955	Largemouth bass Black crappie Bluegill sunfish Fathead minnow
REGION V					
San Dimas Reservoir	Los Angeles	12	16	Aug. 1954	Rainbow trout
Puddingstone Reservoir	Los Angeles	80	490	Oct. 1954	Largemouth bass Channel catfish Threadfin shad Redear sunfish
Yorba Linda Reservoir	Orange	38	87	Feb. 1955	Largemouth bass
Tuffree Reservoir	Orange	8	10	Feb. 1955	Largemouth bass
Farm Pond	San Diego	2	2	July 1955	Largemouth bass Bluegill sunfish
Bridgeport Reservoir	Mono	400	3,000	Nov. 1955	Rainbow trout Brown trout
Hodges Reservoir	San Diego	250	1,317	Jan. 1956	Largemouth bass Bluegill sunfish White crappie Catfish
Mockingbird Reservoir	Riverside	15	20	Mar. 1956	Largemouth bass

* Not suitable habitat for game fish.
† Restocked naturally through steelhead spawning.
‡ Sixteen miles of canal above and below Dallas Warner Reservoir also treated.

GAME FARM UNITS AND YEARLY CAPACITY

TABLE 24

Game farm	County	Yearly capacity
Redding	Shasta	3,500
Chico	Butte	5,500
Marysville	Yuba	5,500
Sacramento	Sacramento	10,000
Yountville	Napa	15,000
Los Banos	Merced	3,500
Fresno	Fresno	8,500
Porterville	Tulare	3,500
Castaic	Los Angeles	2,500
Los Serranos	San Bernardino	6,500
Valley Center	San Diego	3,000
Brawley	Imperial	6,000
Total		73,000

TABLE 25

NUMBER OF MOUNTAIN LIONS BOUNTIED BY DEPARTMENT OF FISH AND GAME

County	Total bountied 1907-1952	Yearly average 1906-1952	Number bountied annually			Total
			1953	1954	1955	
Alameda	37	1	2	5	5	49
Alpine	3		2	2		7
Amador	27	1		1	1	29
Butte	82	2	2	1		85
Calaveras	62	1				62
Colusa	92	2				92
Contra Costa	1		1	1		3
Del Norte	221	5	1	2	2	226
El Dorado	236	5	1			237
Fresno	209	5	6	5	3	223
Glenn	276	6	1	4	21	302
Humboldt	1,097	24	6	10	3	1,116
Imperial	2					2
Inyo	26	1			11	37
Kern	481	10	10	11	7	509
Kings	1					1
Lake	518	11	3	3	10	534
Lassen	14					14
Los Angeles	196	5			4	200
Madera	107	2	17	2	1	127
Mariu	3			1		4
Mariposa	157	3	2	3		162
Mendocino	720	16	6	4	6	736
Merced	10				2	12
Modoc	6					6
Mono	53	1		3	11	67
Monterey	712	15	12	23	23	770
Napa	4					4
Nevada	38	1				38
Orange	16				1	17
Placer	119	3		1		120
Plumas	20					20
Riverside	108	2	7		1	116
Sacramento	1					1
San Benito	68	1	1			69
San Bernardino	178	4		1		179
San Diego	283	6	2	1	5	291
San Joaquin	2		1			3
San Luis Obispo	264	6	7	7		278
San Mateo	1				1	2
Santa Barbara	451	10		4		455
Santa Clara	169	4	7	3	7	186
Santa Cruz	4				1	5
Shasta	729	16	17	9	5	760
Sierra	43	1				43
Siskiyou	567	12	15	26	9	617
Solano						
Sonoma	36	1				36
Stanislaus	26	1	2	1		29
Sutter	1					1
Tehama	452	10	5	1	1	459
Trinity	989	21	10	5	9	1,013
Tulare	533	12	21	16	29	599
Tuolumne	187	4				187
Ventura	178	4	14	4	5	201
Yolo	3					3
Yuba	46	1				46
Total	10,865	236	181	160	184	11,390

TABLE 26

CALIFORNIA JACK MACKEREL LANDINGS BY SEASONS

Season (May 1-April 30)	Pounds	Season (May 1-April 30)	Pounds
1926-27	365,245	1941-42	1,917,129
1927-28	425,197	1942-43	9,794,416
1928-29	556,550	1943-44	8,454,883
1929-30	673,936	1944-45	13,742,894
1930-31	310,894	1945-46	9,280,072
1931-32	672,679	1946-47	31,146,258
1932-33	465,351	1947-48	142,660,570
1933-34	1,106,317	1948-49	55,690,542
1934-35	1,653,549	1949-50	64,987,587
1935-36	9,849,115	1950-51	136,374,757
1936-37	5,757,158	1951-52	74,990,835
1937-38	8,242,112	1952-53	151,470,361
1938-39	3,925,278	1953-54	35,061,944
1939-40	1,117,895	1954-55	18,834,458
1940-41	1,749,646	1955-56	59,347,100

TABLE 27

ABALONE LANDINGS

Year	Pounds	Year	Pounds
1948	3,228,927	1952	4,784,033
1949	3,599,998	1953	4,719,504
1950	3,954 791	1954	4,099,525
1951	4,084,115	1955	4,185,875

TABLE 28

PACIFIC OYSTER LANDINGS

Year	Pounds	Year	Pounds
1933	68,762	1945	309,738
1934	50,240	1946	88,006
1935	299,375	1947	46,035
1936	310,683	1948	166,524
1937	680,081	1949	235,134
1938	1,207,421	1950	143,612
1939	1,659,355	1951	133,700
1940	1,292,505	1952	180,141
1941	1,717,781	1953	161,520
1942	609,233	1954	460,620
1943	741,105	1955	1,635,067
1944	636,686		

TABLE 29

PACIFIC MACKEREL LANDINGS BY SEASONS

Season (May 1-April 30)	Pounds	Season (May 1-April 30)	Pounds
1926-27	3,593,962	1941-42	71,754,709
1927-28	6,455,033	1942-43	48,220,187
1928-29	39,405,114	1943-44	77,853,106
1929-30	56,694,637	1944-45	80,785,356
1930-31	12,805,751	1945-46	52,002,734
1931-32	15,152,465	1946-47	58,896,372
1932-33	10,850,403	1947-48	39,627,373
1933-34	72,873,851	1948-49	38,202,903
1934-35	113,464,209	1949-50	50,061,684
1935-36	146,387,327	1950-51	33,890,004
1936-37	100,745,270	1951-52	31,904,919
1937-38	70,445,621	1952-53	18,761,833
1938-39	76,064,647	1953-54	7,612,679
1939-40	99,960,747	1954-55	27,210,207
1940-41	107,553,929	1955-56	26,896,627

TABLE 30

POUNDS OF LIVE BAIT TAKEN BY THE VESSELS SUPPLYING THE PARTY BOAT FLEET

Year	Pounds	Year	Pounds
1947	7,701,000	1952	14,365,000
1948	9,145,000	1953	12,978,000
1949	9,065,000	1954	13,672,000
1950	11,058,000	1955	12,486,000
1951	13,228,000		

TABLE 31

ALBACORE
LANDINGS AND SHIPMENTS IN POUNDS

Year	Fishing boat landings	Shipments	Total
1948	36,460,157	1,149,632	37,609,789
1949	44,006,280	284,040	44,290,320
1950	61,745,994	4,378,420	66,124,414
1951	30,915,342	17,520,891	48,436,233
1952	49,802,791	22,525,248	72,328,039
1953	33,834,626	46,186,816	80,021,442
1954	26,107,290	38,466,383	64,573,673
1955	29,001,631	44,844,675	73,846,306

TABLE 32

BLUEFIN TUNA

LANDINGS AND SHIPMENTS IN POUNDS

Year	Fishing boat landings	Shipments	Total
1948	6,528,807	168,180	6,696,987
1949	4,389,390		4,389,390
1950	2,738,963	107,878	2,846,841
1951	3,862,394	2,112	3,864,506
1952	4,576,685		4,576,685
1953	9,772,855	62,447	9,835,302
1954	21,024,820	638,286	21,663,106
1955	13,609,177	343,346	13,952,523

TABLE 33

YELLOWFIN TUNA

LANDINGS AND SHIPMENTS IN POUNDS

Year	Fishing boat landings	Shipments	Total
1948	191,723,801		191,723,801
1949	184,972,285	639,809	185,612,094
1950	182,315,834	8,130,632	190,446,466
1951	160,246,175	13,422,415	173,668,590
1952	178,437,493	7,080,197	185,517,690
1953	132,086,346	8,458,606	140,544,952
1954	119,401,795	29,701,898	149,103,693
1955	122,291,864	40,526,143	162,818,007

TABLE 34

SKIPJACK

LANDINGS AND SHIPMENTS IN POUNDS

Year	Fishing boat landings	Shipments	Total
1948	58,770,706	1,364	58,772,070
1949	78,521,918	52,739	78,574,657
1950	124,779,419	3,261,659	128,041,078
1951	115,886,848	2,750,824	118,637,672
1952	84,736,126	4,155,541	88,891,667
1953	122,306,183	8,347,736	130,653,919
1954	153,756,190	15,707,756	169,463,946
1955	101,837,635	18,687,354	120,524,989

TABLE 35

COMMERCIAL FISHING FLEET

Homeport	1954-55	1955-56
Eureka	417	478
Sacramento	195	207
San Francisco	792	749
Monterey	417	467
Santa Barbara	212	235
Los Angeles	1,611	1,342
San Diego	728	678
Alaska, Washington, Oregon	530	294
Total number of boats	4,902	4,450

TABLE 36

RESIDENCE OF LICENSED COMMERCIAL FISHERMEN

Region of residence	Number of fishermen, 1954-1955	Number of fishermen, 1955-1956
Eureka	886	843
Sacramento	460	472
San Francisco	1,292	1,309
Monterey	971	958
Santa Barbara	451	458
Los Angeles	3,719	3,162
San Diego	3,015	2,503
Alaska, Washington and Oregon fishermen licensed in California	797	528
Mexican Nationals licensed in California	50	31
Other registry	6	13
Totals	11,647	10,277

TABLE 37

CALIFORNIA FISHERIES PRODUCTION

	1954	1955	Total
Total landings and shipments, pounds	713,068,917	710,215,480	1,423,284,397
Cases of fish canned	13,960,379	13,797,287	27,757,666
Tons of fish meal produced	30,278	30,706	60,984
Gallons of fish oil produced	1,408,245	1,502,797	2,911,042
Gallons of liver oil produced	17,298	14,979	32,277

TABLE 38

SALMON LANDINGS IN POUNDS

Year	Ocean caught	Sacramento-San Joaquin Rivers	Other rivers[1]	Total pounds
1916	5,592,216	3,450,787	1,896,591	10,939,594
1917	6,085,997	3,975,487	999,097	11,060,581
1918	5,933,346	5,938,029	1,221,813	13,093,188
1919	7,208,382	4,529,222	1,408,123	13,145,727
1920	6,066,190	3,860,312	1,207,317	11,133,819
1921	4,483,105	2,511,127	996,700	7,990,932
1922	4,338,317	1,765,066	1,131,741	7,235,124
1923	3,736,924	2,243,945	1,109,391	7,090,260
1924	6,374,573	2,640,110	1,000,586	10,015,269
1925	5,481,536	2,778,846	1,265,371	9,525,753
1926	3,863,677	1,261,776	958,626	6,084,079
1927	4,921,600	920,786	669,543	6,511,929
1928	3,444,306	553,777	480,483	4,478,566
1929	4,033,660	581,497	429,714	5,044,871
1930	4,085,650	1,213,698	703,546	6,002,894
1931	3,666,841	941,605	686,065	5,294,511
1932	2,649,194	1,264,987	703,990	4,618,171
1933	3,657,661	454,253	446,520	4,558,434
1934	3,921,530	397,572		4,319,102
1935	4,773,112	888,868		5,661,980
1936	4,093,475	949,179		5,042,654
1937	5,934,996	974,871		6,909,867
1938	2,170,921	1,668,376		3,839,297
1939	2,238,755	496,933		2,735,688
1940	5,160,403	1,515,588		6,675,991
1941	2,945,994	844,963		3,790,957
1942	4,063,306	2,552,944		6,616,250
1943	5,285,527	1,295,424		6,580,951
1944	7,021,848	3,265,143		10,286,991
1945	7,912,754	5,467,960		13,380,714
1946	7,134,472	6,524,991		13,659,463
1947	8,080,780	3,403,808		11,484,588
1948	5,829,377	1,932,493		7,761,870
1949	5,530,674	898,364		6,429,038
1950	5,856,850	1,150,313		7,007,163
1951	5,840,984	1,243,395		7,084,379
1952	6,500,390	702,352		7,202,742
1953	6,973,227	865,723		7,838,950
1954	8,597,663	900,961		9,498,624
1955	9,658,820	2,320,746		11,979,566

The commercial catch of king and silver salmon in California has not been separated. Occasional samples and partial separation for a few areas are available for a few years. The recent samples indicate that the silver salmon constituted about 9 percent by weight of the ocean catch in 1939-1942. Silver salmon are not taken by the Sacramento-San Joaquin fishery.

[1] Eel, Klamath, Mad and Smith Rivers were closed to commercial fishing in 1934.

TABLE 39

SEASONAL CATCH IN TONS * OF SARDINES ALONG THE PACIFIC COAST—EACH SEASON INCLUDES JUNE THROUGH THE FOLLOWING MAY

Season	British Columbia	Washington	Oregon	Total Pacific northwest	California						Grand total	California percent of total
					Floating plants	San Francisco	Monterey	San Pedro	San Diego	Total California		
1916-17							7,710	17,380	2,440	27,530	27,530	100
1917-18	80			80		70	23,810	41,340	7,360	72,580	72,660	100
1918-19	3,640			3,640		450	35,750	32,530	6,810	75,540	79,180	95
1919-20	3,280			3,280		1,000	43,040	16,580	6,410	67,030	70,310	95
1920-21	4,400			4,400		230	24,960	11,740	1,520	38,450	42,850	90
1921-22	990			990		80	16,290	19,220	910	36,500	37,490	97
1922-23	1,020			1,020		110	29,210	33,170	2,620	65,110	66,130	98
1923-24	970			970		190	15,920	35,040	2,780	83,930	84,900	99
1924-25	1,370			1,370		560	67,310	96,330	8,820	173,020	174,390	99
1925-26	15,950			15,950		560	69,010	61,990	5,710	137,270	153,220	90
1926-27	48,500			48,500		3,520	81,860	64,720	2,110	152,210	200,710	76
1927-28	68,430			68,430		16,690	98,020	67,900	4,650	187,260	255,690	73
1928-29	80,510			80,510		13,520	120,290	119,250	1,420	254,480	334,990	76
1929-30	86,340			86,340		21,960	160,050	140,540	2,620	325,170	411,510	79
1930-31	75,070			75,070	10,960	25,970	109,620	38,490	80	185,120	260,190	71
1931-32	73,600			73,600	31,040	21,610	69,080	42,660	260	164,650	238,250	69
1932-33	44,350			44,350	58,790	18,630	80,600	83,600	60	250,680	295,030	85
1933-34	4,050			4,550	67,820	36,340	152,480	125,050	1,750	383,440	387,490	99
1934-35	43,000			43,000	112,040	69,000	230,860	178,820	4,860	595,580	638,580	93
1935-36	45,320	10	26,230	71,560	150,830	76,150	184,470	138,400	10,650	560,500	632,060	89
1936-37	41,450	6,560	14,200	65,210	235,610	141,100	206,710	138,110	4,590	726,120	791,330	92
1937-38	48,080	17,100	16,660	81,840	67,580	133,720	104,930	109,950	380	416,560	498,400	84
1938-39	51,770	26,480	17,020	95,270	43,890	201,200	180,990	146,400	2,780	575,260	670,530	86
1939-40	5,520	17,760	22,330	45,610		212,450	227,870	101,820	110	542,250	587,860	92
1940-41	28,770	810	3,160	32,740		118,090	165,700	175,590	1,200	460,580	493,320	93
1941-42	60,050	17,100	15,850	93,000		186,590	250,290	148,910	1,580	587,370	680,370	86
1942-43	65,880	580	1,950	68,410		115,880	184,400	201,510	2,870	504,660	573,070	88
1943-44	88,740	10,440	1,820	101,000		126,510	213,620	135,310	2,690	478,130	579,130	83
1944-45	59,120	20		59,140		136,600	237,250	178,290	2,770	554,910	614,050	90
1945-46	34,300	2,310	90	36,700		84,100	145,520	173,110	950	403,680	440,380	92
1946-47	3,990	6,140	3,960	14,090		2,870	31,240	194,720	4,770	233,600	247,690	94
1947-48	490	1,360	6,930	8,780		90	17,630	101,150	2,460	121,330	130,110	93
1948-49		50	5,320	5,370		110	47,830	131,860	3,920	183,720	189,090	97
1949-50						16,090	130,990	187,260	3,280	337,620	337,620	100
1950-51						12,730	19,100	318,350	2,910	353,090	353,090	100
1951-52						80	640	127,030	1,350	129,100	129,100	100
1952-53							10	5,680	30	5,720	5,720	100
1953-54								4,140	320	4,460	4,460	100
1954-55							10	66,770	490	67,270	67,270	100
1955-56							470	73,990		74,460	74,460	100

* Data for British Columbia were supplied by the Canadian Bureau of Statistics and the Province of British Columbia, those for Washington by the Washington Department of Fisheries and for Oregon by the Fish Commission of Oregon. Tonnages delivered to the floating plants were compiled by the United States Fish and Wildlife Service from the books of the companies operating off the California Coast. California landings were derived from the records of the California Department of Fish and Game.

TABLE 40

SUMMARY

HATCHERY REARED TROUT AND SALMON PLANTED

1954-55 FISCAL YEAR

	Fingerling		Catchable		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
RESIDENT FISH						
Trout:						
Rainbow	5,730,975	39,989	7,595,269	1,186,963	13,326,244	1,226,752
Eastern brook	1,361,446	4,302			1,361,446	4,302
Brown	855,354	1,544	3,250	1,000	858,604	2,544
Golden	272,160	143			272,160	143
Cutthroat (Lahontan)	314,285	739	1,386	3,465	315,671	4,204
Total	8,534,220	46,717	7,599,905	1,191,428	16,134,125	1,238,145
Salmon:						
Kokanee	898,490	290			898,490	290
Resident fish total	9,432,910	47,007	7,599,905	1,191,428	17,032,615	1,238,435
ANADROMOUS FISH						
Steelhead	526,930	1,268			526,930	1,268
Cutthroat (Coastal)	124,343	696			124,343	696
Total	651,273	1,964			651,273	1,964
Salmon:						
King	210,150	290			210,150	290
Anadromous total	861,423	2,254			861,423	2,254
GRAND TOTAL	10,294,133	49,261	7,599,905	1,191,428	17,894,038	1,240,689

TABLE 41

SUMMARY

HATCHERY REARED TROUT AND SALMON PLANTED

1955-56 FISCAL YEAR

	Fingerling		Subcatchable		Catchable		Total	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
RESIDENT FISH								
Trout:								
Rainbow	8,452,897	62,095	42,610	3,510	7,571,821	1,239,500	16,067,328	1,305,105
Brown	808,844	1,078			12,900	1,076	821,744	2,154
Cutthroat (Lahontan)	654,025	1,550					654,025	1,550
Eastern brook	1,320,993	3,942					1,320,993	3,942
Golden	176,130	115					176,130	115
Splake	20,513	105					20,513	105
Total	11,433,402	68,885	42,610	3,510	7,584,721	1,240,576	19,060,733	1,312,971
Salmon:								
Kokanee	660,235	342					660,235	342
Resident total	12,093,637	69,227	42,610	3,510	7,584,721	1,240,576	19,720,968	1,313,313
ANADROMOUS FISH								
Trout:								
Steelhead	577,111	5,630					577,111	5,630
Cutthroat (Coastal)	103,731	579					103,731	579
Total	680,842	6,209					680,842	6,209
Salmon:								
King	5,285,435	8,234					5,285,435	8,234
Silver	59,932	1,350	43,925	3,906			103,857	5,256
Total	5,345,367	9,584	43,925	3,906			5,389,292	13,490
Anadromous total	6,026,209	15,793	43,925	3,906			6,070,134	19,699
GRAND TOTAL	18,119,846	85,020	86,535	7,416	7,584,721	1,240,576	25,791,102	1,333,012

TABLE 42

ANCHOVY LANDINGS IN POUNDS

Year	Commercial	Live bait	Commercial and live bait
1916	531,209		
1917	528,753		
1918	868,161		
1919	1,609,548		
1920	569,774		
1921	1,946,881		
1922	652,516		
1923	307,074		
1924	346,951		
1925	93,071		
1926	60,157		
1927	368,201		
1928	357,470		
1929	382,445		
1930	319,561		
1931	307,494		
1932	299,217		
1933	317,292		
1934	257,505		
1935	178,970		
1936	195,122		
1937	226,229		
1938	735,144		
1939	2,147,901		
1940	6,317,797		
1941	4,105,382		
1942	1,694,290		
1943	1,570,803		
1944	3,891,029		
1945	1,616,880		
1946	1,921,627		
1947	18,940,521		
1948	10,835,930	7,450,993	18,286,923
1949	3,322,273	5,604,735	8,927,008
1950	4,878,687	7,647,640	12,526,327
1951	6,954,852	10,283,730	17,238,582
1952	55,782,870	13,620,879	69,403,749
1953	84,503,703	12,783,016	97,286,719
1954	42,410,214	13,372,042	55,782,256
1955	44,691,582	12,250,890	56,942,472

TABLE 43

POUNDS AND VALUE [1] OF COMMERCIAL FISH LANDINGS AND SHIPMENTS INTO CALIFORNIA

	1954		1955	
	Pounds	Value	Pounds	Value
Yellowfin tuna	149,103,693	$25,559,675	162,818,007	$24,483,408
Skipjack	169,463,946	25,680,987	120,524,989	15,979,588
Albacore	64,573,673	13,142,936	73,846,306	12,173,046
Salmon	10,094,658	3,031,939	12,418,619	4,088,293
Sardine	136,509,767	3,701,222	145,607,749	3,088,260
Bluefin tuna	21,663,106	3,655,684	13,952,523	1,984,876
Sole	19,732,179	1,144,770	17,894,493	1,035,106
Crab	7,828,208	1,146,261	6,119,320	976,291
Jack mackerel	17,333,547	661,209	35,754,707	710,579
Anchovy	42,410,214	850,527	44,691,582	596,613
Pacific mackerel	25,392,604	808,592	23,311,211	531,803
Rockfish	12,650,541	553,756	12,681,697	513,699
Spiny Lobster	901,400	409,537	859,125	433,722
Abalone	4,099,525	376,924	4,185,875	423,341
Squid	8,155,105	177,223	14,271,968	234,264
White sea bass	1,206,551	250,804	906,617	216,177
Sablefish	2,804,918	253,225	2,497,177	204,439
Barracuda	1,588,611	235,484	1,137,670	176,919
California halibut	662,139	138,499	481,511	103,167
Lingcod	947,343	68,741	964,926	71,484
Ocean shrimp	296,797	26,950	827,733	70,973
Swordfish	23,055	12,341	135,740	58,520
Bigeye tuna	1,249,937	155,742	512,534	56,507
Black sea bass	409,653	55,551	365,487	54,010
Bay shrimp	744,868	52,812	693,654	51,671
All other	13,560,208	1,100,221	12,710,358	755,045
Totals	713,406,246	$83,251,512	710,171,578	$69,071,801

[1] Value to the fishermen.

TABLE 44

TOTAL ANNUAL LANDINGS AND SHIPMENTS INTO CALIFORNIA OF COMMERCIAL FISH, MOLLUSKS, AND CRUSTACEANS

Includes Sardine Deliveries to Reduction Ships During 1930 Through 1938

Year	Pounds	Year	Pounds
1916	95,002,695	1936	1,764,900,136
1917	209,876,670	1937	1,362,983,717
1918	261,134,265	1938	1,310,595,651
1919	266,270,240	1939	1,486,534,906
1920	222,004,376	1940	1,297,517,441
1921	135,347,826	1941	1,529,147,645
1922	182,343,333	1942	1,173,414,078
1923	253,874,581	1943	1,234,049,119
1924	340,445,919	1944	1,459,445,859
1925	437,502,232	1945	1,216,467,433
1926	394,964,393	1946	919,850,476
1927	487,166,143	1947	795,498,998
1928	583,526,751	1948	900,499,994
1929	856,854,055	1949	1,135,338,504
1930	702,188,795	1950	1,366,677,048
1931	502,389,875	1951	904,099,052
1932	556,139,053	1952	694,978,340
1933	821,805,007	1953	617,329,389
1934	1,390,798,650	1954	713,409,605
1935	1,448,016,584	1955	710,171,578

TABLE 45

SALMON AND STEELHEAD COUNTING STATIONS

KLAMATHON ROCKS, KLAMATH RIVER, SISKIYOU COUNTY

Year	King salmon
1954-55	2,032
1955-56	14,946

SHASTA RIVER RACKS, SHASTA RIVER, SISKIYOU COUNTY

Year	King salmon
1954-55	2,624
1955-56	1,807

SWEASEY DAM, MAD RIVER, HUMBOLDT COUNTY *

Year	King salmon	Silver salmon	Steelhead
1954-55	403	59	2,372
1955-56	390	2	148

BENBOW DAM, SOUTH FORK EEL RIVER, HUMBOLDT COUNTY

Year	King salmon	Silver salmon	Steelhead
1954-55	5,406	6,016	14,000
1955-56	3,974	6,054	11,443

CLOUG DAM, MILL CREEK, TEHAMA COUNTY

Year	King salmon (fall run)	King salmon (spring ruo)	Steelhead
1954-55	2,901	2,967	1,481
1955-56	1,722	2,233	1,208

WOODBRIDGE DAM, MOKELUMNE RIVER, SAN JOAQUIN COUNTY

Year	King salmon	Steelhead
1954-55	3,941	34
1955-56	2,193	30

PARROT-PHELAN DAM, BUTTE CREEK, BUTTE COUNTY

Year	King salmon (spring run)
1954-55	245†
1955-56	No count

* December, 1955, floods damaged ladder to point where fish could not ascend it. King salmon count was believed to be completed before damage.
† Partial count.

TABLE 46

DEER BAG IN SPECIAL HUNTS

Year	Male	Female	Unclassified*	Total
1949-50	246	231		477
1950-51	1,996			
1950-51	563	1,433		1,996
1951-52	311	2,914		3,225
1952-53	929	775	228	1,932
1953-54	451	401	12	864
1954-55	505	1,580	50	2,135
1955-56	1,594	7,828	236	9,658

* Unclassified. Information insufficient to determine sex.

TABLE 47

STREAM IMPROVEMENT

July 1, 1954 to June 30, 1956 (Inclusive)

Name of water and county*	Number of pool forming devices	Number of fish screens installed	Number of fish ladders built	Flow maintenance dams built	Barriers eliminated
REGION I					
Trapper Creek, S		1			
Know Nothing Creek, S					1
Shackelford Creek, S		3			
Beaver Creek, S		1			
Bogus Creek, S		1			
Cottonwood Creek, S		4			
Mill Creek, S		1			
Deer Creek, T		1	1		
Mill Creek, T		2			
Swift Creek, Tr		1			
REGION II					
Mokelumne River, SJ			1		
Cosumnes River, Sac		1			
Mokelumne River, South Fork, Cal	7				
Taylor Creek, ED				2	1
Rubicon River, ED				4	
Upper Truckee River, ED				1	
REGION III					
Sulphur Creek, Son					1
Nuns Creek, Son					1
Zyante Creek, SCz					2
Fall Creek, SCz					3
Mill Creek, Son					1
Corralitos Creek, SCz					1
Bean Creek, SCz					1
San Francisquito, SM		1	1		
Chorro Creek, SLO			1		
Carriga Creek, Son			1		
REGION IV					
Big Creek, F					2
Cherry Creek, Tuo				9	
Granite Creek, Mad				3	
Chiquito Creek, Mad				1	
REGION V					
Big Rock Creek, LA		1			
Arroyo Seco Creek, LA	15				
San Gabriel River, LA	3				
San Juan Creek, O	9	1			
Dark Canyon Creek, R	4				
Fuller Mill Creek, R	6				
Lower Stone Creek, R	3				
Blue Jay Creek, SBd		1			
City Creek, SBd	9				
Grass Valley Creek, SBd		1			
Hooks Creek, SBd	9				
Little Bear Creek, SBd	3				
Kitchen Creek, SD	27				
Pine Valley Creek, SD	2				
Cachuma Creek, SB	1				
Willow Creek, SB	13				
Ventura River, North Fork, V	45				
Reyes Creek, V	45				
Rose Valley Creek, V	2				
Totals	203	21	5	20	14

* Abbreviations of county names in order of appearance in the table: S—Siskiyou; T—Tehama; Tr.—Trinity; SJ—San Joaquin; Sac.—Sacramento; Cal—Calaveras; ED—El Dorado; Son.—Sonoma; SCz—Santa Cruz; SM—San Mateo; SLO—San Luis Obispo; F—Fresno; Tuo—Tuolumne; Mad.—Madera, LA—Los Angeles; O—Orange; R—Riverside; SBd—San Bernardino; SD—San Diego; SB—Santa Barbara; V—Ventura.

TABLE 48

MARKET CRAB LANDINGS

Year	Pounds	Year	Pounds
1916	1,296,912	1936	2,311,802
1917	2,580,840	1937	1,627,753
1918	1,619,280	1938	3,873,600
1919	1,304,904	1939	5,953,361
1920	1,220,568	1940	5,151,014
1921	800,952	1941	4,260,340
1922	860,328	1942	2,414,110
1923	1,075,800	1943	2,315,338
1924	1,506,816	1944	2,925,316
1925	3,234,312	1945	4,333,895
1926	3,296,280	1946	9,633,630
1927	2,960,712	1947	10,733,398
1928	3,574,464	1948	11,912,191
1929	1,792,776	1949	11,133,046
1930	1,992,384	1950	11,721,352
1931	2,231,384	1951	11,568,353
1932	2,433,987	1952	12,941,418
1933	3,208,494	1953	8,252,777
1934	3,768,081	1951	7,829,651
1935	3,680,188	1955	6,119,320

TABLE 49

HUNTING LICENSE SALES

Year	Number licenses	Year	Number licenses
1907-08	113,975	†1932-33	154,031
1908-09	111,911	1933-34	171,139
1909-10	124,421	1934-35	174,667
1910-11	138,669	1935-36	190,257
1911-12	141,777	1936-37	225,448
1912-13	159,762	1937-38	248,365
1913-14	159,164	1938-39	252,117
1914-15	161,402	1939-40	270,095
1915-16	155,522	1940-41	291,507
1916-17	166,372	1941-42	331,878
1917-18	No record	1942-43	268,128
1918-19	No record	1943-44	284,370
1919-20	No record	1944-45	318,910
1920-21	225,454	1945-46	393,282
1921-22	222,791	1946-47	487,307
1922-23	226,381	1947-48	507,552
1923-24	246,299	1948-49	504,173
1924-25	226,421	1949-50	496,735
1925-26	231,305	1950-51	491,424
1926-27	253,532	1951-52	534,684
1927-28	257,738	1952-53	588,764
1928*	228,696	1953-54	613,928
1929	241,709	1954-55	620,587
1930	231,970	‡1955-56	635,100
1931	214,577		

* Fee increased from $1 to $2.
† Licenses on 18-month period. Fee increased 50 percent for period.
‡ Estimated.

TABLE 50

ANGLING LICENSE SALES

Year	Number sold	Year	Number sold
1914	81,965	1935	224,661
1915	87,262	1936	300,611
1916	111,994	1937	326,745
1917	No record	1938	348,227
1918	No record	1939	366,452
1919	No record	1940	390,342
1920	No record	1941	460,715
1921	176,873	1942	433,431
1922	183,116	1943	447,352
1923	225,171	1944	436,940
1924	202,690	1945	557,536
1925	222,983	1946	768,816
1926	246,167	1947	884,747
1927	262,886	†1948	960,146
1928*	217,788	1949	992,519
1929	225,774	1950	983,019
1930	248,319	1951	1,015,469
1931	242,857	1952	1,098,597
1932	212,662	1953	1,187,328
1933	175,936	1954	1,240,060
1934	211,190	‡1955	1,302,927

* Fee increased from $1 to $2.
† Fee increased from $2 to $3.
‡ Estimated.

TABLE 51

DEER TAG SALES

Year	Number sold	Year	Number sold
1927	110,760	1942	116,121
1928	105,638	1943	147,795
1929	115,472	1944	178,250
1930	123,999	1945	214,662
1931	129,005	1946	282,060
1932	96,702	1947	299,610
1933	95,776	1948	300,405
1934	108,923	1949	309,829
1935	110,808	1950	312,652
1936	126,855	1951	342,900
1937	136,389	1952	369,149
1938	141,598	1953	370,938
1939	152,924	1954	397,566
1940	163,285	*1955	410,205
1941	173,699		

* Estimated.

TABLE 52

PHEASANT TAG SALES

Year	Number sold	Year	Number sold
1943	121,186	1952	205,041
1944	105,923	1953	214,753
1949	171,352	1954	221,621
1950	160,661	1955	219,587
1951	188,765		

* Estimated.

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